WATERFORD 3 SES
PLANT OPERATING MANUAL

LOUISIANA POWER & LIGHT

MIDDLE SOUTH UTILITIES SYSTEM

POM VOLUME 9
POM SECTION 6

MN-6-011
REVISION 0
APPROVAL DATE: March 4, 1982
EFFECTIVE DATE:

MAINTENANCE PROCEDURE

GENERAL TORQUING AND DETENSIONING

PORC Meeting No. 82-09

Reviewed: [signature]
PORC Chairman

Approved: [signature] for D. Blosten
Plant Manager-Nuclear

WATERFORD 3 SES

DEPARTMENTAL PROCEDURE

CHANGE/REVISION/DELETION REQUEST

Procedure No. MM-6-011 Title General Training & Retraining

Effective Date _____
(If different from Group Head approval date)

Complete A, B, or C

A. Change No. 3

B. Revision No. X0 8-17-83

C. Deletion _____

REASON FOR CHANGE, REVISION, OR DELETION

To conform to central records format

REQUIRED SIGNATURES

Originator _____ Date 8/5/83

Technical Review _____ Date 8-9-83

SAFETY EVALUATION

Does this change, revision, or deletion:	YES	NO
1. Change the facility as described in the FSAR?	___	✓
2. Change the procedures as described in the FSAR?	___	✓
3. Conduct tests/experiments not described in the FSAR?	___	✓
4. Create a condition or conduct an operation which exceeds or could result in exceeding, the limits in Technical Specification?	___	✓

If the answer to any of the above is yes, complete and attach a 10 CFR 50.59 Safety Evaluation checklist.

Safety Evaluation _____ Date 8/8/83

Temporary Approval * _____ Date _____

Temporary Approval * _____ Date _____

QC Review L. L. Heinzer Date 8-10-83

Group/~~Department~~ Head _____ Date 8/15/83

*Temporary approval must be followed by QC Review and Group/Department Head approval within 14 days.

WATERFORD 3 SES

PLANT OPERATING MANUAL

CHANGE/REVISION/DELETION REQUEST

Procedure No. MM-I-011 Title General Torquing and Detensioning

Effective Date ____________ (if different from PM-N approval date)

Complete A, B, or C

A. Change No. 2

B. Revision No. 0

C. Deletion ________

REASON FOR CHANGE, REVISION, OR DELETION

Add place on Attachment 10.1 for the item torqued and the location of the item.

REQUIRED SIGNATURES

Originator [signature] Date 10/11/82

Technical Review N/A Date N/A

SAFETY EVALUATION

Does this change, revision, or deletion:	YES	NO
1. Change the facility as described in the FSAR?		✓
2. Change the procedures as described in the FSAR?		✓
3. Conduct tests/experiments not described in the FSAR?		✓
4. Create a condition or conduct an operation which exceeds, or could result in exceeding, the limits in Technical Specifications?		✓

If the answer to any of the above is yes, complete and attach a 10 CFR 50.59 Safety Evaluation checklist.

Safety Evaluation [signature] Date 10/11/82

Group/Dep't. Head Review N/A Date N/A

Temporary Approval* [signature] Date 10/11/82 (NOS)

Temporary Approval* [signature] Date 10/11/82

QC Review [signature] Date 10-13-82

PORC Review [signature] Date 10-20-82 Meeting No. ~~82-41B~~ 82-42A

Plant Manager-Nuclear Approval [signature] Date 10-20-82

*Temporary approval must be followed by Plant Manager-Nuclear approval within 14 days.

WATERFORD 3 SES
PLANT OPERATING MANUAL
CHANGE/REVISION/DELETION REQUEST

CHANGE NO. 1
VISION NO. 0
LATION YES NA NO ✓

MAJOR CHANGE YES NA NO ✓
(affects intent)
TEMPORARY CHANGE YES NA NO ✓
Effective From NA TO NA

PROCEDURE NO. MM-6-011
TITLE General Torquing and Detensioning

DESCRIPTION OF CHANGE: (attach additional Description of Change forms and marked up copies of the procedure as required)
1) added additional attachment (incorporated a new attachment 10.5 and changed the old Att. 10.5 to Att. 10.6)

JUSTIFICATION: (attach additional sheets as required)
To add torque values for flange connections

ORIGINATED BY Don BAGGETT DATE 5/20/82

GROUP/DEPT. HEAD REVIEW [signature] DATE 5-21-82
Technical Review Required YES ___ NO ✓
TECHNICAL REVIEW PA DATE NA

SAFETY EVALUATION

Does this change, revision, or deletion:	YES	NO
1. Change the facility as described in the FSAR?		X
2. Change the procedures as described in the FSAR?		X
Conduct tests/experiments not described in the FSAR?		X
Create a condition or conduct an operation which exceeds or could result in exceeding, the limits in Technical Specifications?		X

If the answer to any of the above is yes, complete and attach a 10CFR 50.59 Safety Evaluation checklist.

REVIEWED BY [signature] DATE 5-21-82

FINAL GROUP/DEPT. HEAD APPROVAL [signature] DATE 5-21-82

TEMPORARY APPROVAL - Minor Changes Only

NA DATE NA (SRC)
NA DATE NA

Note: Temporary Approval must be followed by PORC approval within fourteen working days.

PERMANENT APPROVAL

PORC CHAIRMAN [signature] DATE 5/27/82 PORC MTG. 82-21A

PLANT MANAGER [signature] DATE 5/28/82

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11	Revision 0 Change 2
11	Revision 0 Change 3

1.0 PURPOSE

1.1 The purpose of this procedure is to:

1.1.1 Provide a Torquing Documentation Worksheet for the collection of information on torquing specific items.

1.1.2 Provide data to determine torque values, increments and sequences when not specified in another procedure, vendor manual, instruction, bulletin or drawing.

1.1.3 Provide instructions for the use of manual and hydraulic torque wrenches, adapters and torque multipliers.

1.2 Portions of this procedure may be used as specified by the Mechanical Maintenance Supervisor when torquing requirements are not delineated in other procedures or when documentation of torquing is required.

1.3 This procedure is not intended to be used as a stand-alone document to perform maintenance or repair activities. It should be used in conjunction with other work documents that specify initial conditions, prerequisites, precautions and limitations, and steps used to perform the actual maintenance or repair activity (for example, a maintenance or repair procedure or a Condition Identification Work Authorization).

2.0 REFERENCES

2.1 MM-1-002, Mechanical Maintenance Practices

2.2 MM-1-004, Mechanical Maintenance Tool Room Control

2.3 UNT-7-003, Control of Expendable Materials

2.4 (Later), Operating and Maintenance Manual - PHW 1.5 Hydraulic Wrench

2.5 (Later), Operating and Maintenance Manual - PHW 15 Hydraulic Wrench

2.6 (Later), Operating Manual - Model 4250 R-A Remote Control Pumping Unit

2.7 457000752, Williams Torque Wrench Bulletin

2.8 457000110, Operating and Maintenance Manual - KSV Diesel Generator

2.9 UNT-7-005, Cleanliness Control

3.0 PREREQUISITES

3.1 Torquing devices to be used are calibrated and controlled in accordance with Reference 2.2, Mechanical Maintenance Tool Room Control.

4.0 PRECAUTIONS AND LIMITATIONS

4.1 The preferred method of torquing is to use manual torque wrenches without adapters or multipliers. If the final torque value is outside the range of manual torque wrenches, accessibility is limited, or other reasons prevent the use of manual torque wrenches without adapters or multipliers, refer to Attachment 10.2, Use of Torque Wrenches and Accessories, and Attachment 10.3, Use of Hydraulic Torque Wrenches, to determine the best torquing method.

4.2 When torque values will exceed 100 ft-lbs and a torque multiplier will not be used, two men should be used to pull on the torque wrench.

4.3 Ensure proper footing and balance while torquing and detensioning.

4.4 Where applicable, and if the equipment is physically accessible, one person should hold the socket engaged on the fastener while force is being applied to the wrench by a second person.

4.5 When using hydraulic wrenches, clear unnecessary personnel from the area, rope off the area (if possible), and keep personnel clear of the high-pressure hoses and the hydraulic wrench.

4.6 Fasteners should be clean and free of nicks, paint, and debris. If necessary, cleaning shall be performed with an LP&L-approved solvent Reference 2.3, Control of Expendable Materials, or with a Grade A water wash as per Reference 2.9, Cleanliness Control, followed by a thorough drying with lint-free cloths.

4.7 The preferred sources of data for torque values, increments, and sequences are specific vendor manuals, instructions, bulletins, drawings, or other approved site procedures. However, when these sources offer no such data, the attachments to this procedure shall be used.

5.0 INITIAL CONDITIONS

NONE

6.0 MATERIAL AND TEST EQUIPMENT

6.1 As required, the following calibrated torquing devices:

6.1.1 Manual torque wrenches

> NOTE
> Manual torque wrenches must have an adequate range to ensure that the final torque values will be within the mid-range of the wrench.

6.1.2 Adapters

6.1.3 Multipliers

6.1.4 Hydraulic torque wrenches

6.1.4.1 A supply of 80 to 110 psig air and air hose approximately 50 feet long

6.1.4.2 Hydraulic hoses

6.1.4.3 Pumping units

6.1.4.4 SAE 10 nondetergent oil

6.2 Lint-free cloths

6.3 "Never-Seez" or other LP&L-approved thread lubricant

6.4 Grade A water

6.5 Sockets

6.6 C-clamps with steel bar stock or other suitable reaction structure if required

6.7 LP&L-approved marker

7.0 ACCEPTANCE CRITERIA

7.1 TORQUING

7.1.1 The specified torquing increments and sequence have been followed and the final torque value as per Attachment 10.1, Torquing Documentation Worksheet, has been achieved but not exceeded on all fasteners.

7.2 DETENSIONING

7.2.1 The specified detensioning increments and sequence have been followed and all fasteners are loose.

8.0 PROCEDURE

8.1 TORQUING

8.1.1 Record on Attachment 10.1, Torquing Documentation Worksheet (Item No. 1), the final torque value required for the specific fastener type and size. (See Attachment 10.5, ~~Generic Torque Values, if necessary.~~ 10.6, IF Necessary) Enter the source of this final torque value (i.e., "Attachment 10.5, 10.6, vendor's manual," etc.). ch 1

8.1.2 Record the M&TE number and calibration due date of the calibrated equipment to be used on Attachment 10.1, Torquing Documentation Worksheet (Item No. 2).

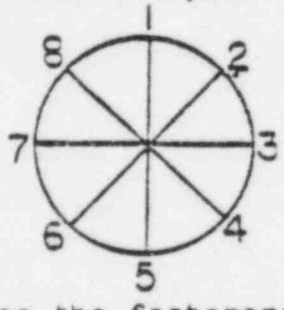
8.1.3 Record on Attachment 10.1, Torquing Documentation Worksheet (Item No. 3), the torque or marking sequence to be used. (See Attachment 10.4, Fastener Marking Sequence, if necessary.) Enter the source of this torque or marking sequence (i.e., "Attachment 10.4," "vendor's manual," etc.).

NOTE

There are two acceptable sequence methods as follows. Both methods will result in the fasteners being torqued in the same sequence. Method 2 is the preferred method and has been used to develop Attachment 10.4, Fastener Marking Sequence.

METHOD No. 1 - TORQUE SEQUENCE

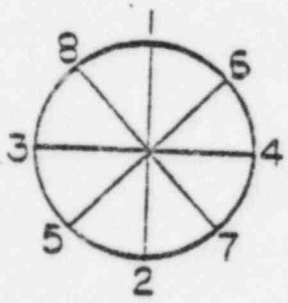
A. The fasteners are marked in numerical sequence either clockwise or counterclockwise around the surface to be torqued. For example:



B. Then, once the fasteners are marked, they are torqued in the order specified by the torque sequence (i.e., "1, 5, 7, 3, 6, 2, 4, 8").

METHOD No. 2 - MARKING SEQUENCE

A. The fasteners are marked in accordance with the marking sequence. For example, with a sequence of "1, 6, 4, 7, 2, 5, 3, 8:"



B. Then, once the fasteners are marked, they are torqued in numerical order (i.e., "1, 2, 3, 4, 5, 6, 7, 8").

8.1.4 Record on Attachment 10.1, Torquing Documentation Worksheet (Item No. 4A), the required fastener torque value for each increment of the torquing operation and the source of the incremental values.

NOTE

If the torquing operation is to be accomplished in more than three increments (or steps), list the additional incremental values in the "Comments" section of Attachment 10.1.

Use 50% of Final Torque Value (FTV) as the first increment, 75% of FTV as the second increment, and 100% of FTV as the third increment, if necessary.

8.1.5 Using the formulas of Attachment 10.2 or the graphs of Attachment 10.3, determine for the equipment listed in Item No. 2 of At-

tachment 10.1, Torquing Documentation Worksheet, the corresponding torque wrench indications/hydraulic pump pressures necessary to produce the required fastener torque values listed in Item No. 4A of Attachment 10.1. Record these indications/pressures in Item No. 4B.

8.1.6 Inspect the fastener threads to ensure that they are clean and free of nicks, paint, and debris. If necessary, clean the threads.

8.1.7 Lubricate the threads with "Never-Seez" or an equivalent LP&L-approved lubricant as per Reference 2.3, Control of Expendable Materials.

8.1.8 Using an LP&L-approved marker in accordance with Reference 2.3, Control of Expendable Materials, mark the flange face as necessary (depending on which method is specified in Item No. 3 of Attachment 10.1, Torquing Documentation Worksheet. See also the note to step 8.1.3).

8.1.9 Torque each fastener to the first increment value (Item No. 4B, Attachment 10.1) in the proper sequence (Item No. 3, Attachment 10.1).

8.1.10 Torque each fastener to the second increment value in the proper sequence.

8.1.11 Continue torquing each fastener to the next increment value and in the proper sequence until all increments have been completed.

8.1.12 Verify that all fasteners are at the final increment value by making as many passes as necessary at that value to ensure that none of the fasteners move.

8.1.13 When all fasteners are at the final increment value, enter the applicable CIWA number and sign and date the "Work Performed By" section of Attachment 10.1.

8.1.14 If the flange face was marked as specified in paragraph 8.1.8, remove the marks with acetone or other LP&L - approved solvent in accordance with Reference 2.3, Control of Expendable Materials.

8.1.15 Submit the completed Torquing Documentation Worksheet to the Mechanical Maintenance Supervisor for review and signature.

8.2 DETENSIONING

> NOTE
>
> Steps 8.2.1 through 8.2.4 should be used to detension fasteners when the vendor's manual or other documents do not contain the specific detensioning process. If the vendor's manual or other documents contain a specific detensioning process, detension the fasteners in accordance with that process using the guidelines presented in paragraphs 8.1.1 through 8.1.11, as necessary.

8.2.1 Record on Attachment 10.1, Torquing Documentation Worksheet (Item No. 3), the torque or marking sequence to be used. (See Attachment 10.4, Fastener Marking Sequence, if necessary.) Enter the source of this torque or marking sequence (i.e., "Attachment 10.4," "vendor's manual," etc.). See also the note to step 8.1.3.

8.2.2 Using an LP&L-approved marker in accordance with Reference 2.3. Control of Expendable Materials, mark the flange face as necessary (depending on which method is specified in Item No. 3 of Attachment 10.1. See also the note to step 8.1.3).

8.2.3 Detension each fastener approximately one-half turn in the proper sequence.

8.2.4 Continue detensioning each fastener approximately one-half turn and in the proper sequence until all fasteners are loose.

8.2.5 If the flange face was marked as specified in paragraph 8.2.2, remove the marks with acetone or other LP&L - approved solvent in accordance with Reference 2.3, Control of Expendable Materials.

9.0 SETPOINTS

NONE

10.0 ATTACHMENTS

10.1 Torquing Documentation Worksheet

10.2 Use of Torque Wrenches and Accessories

10.3 Use of Hydraulic Torque Wrenches

10.4 Fastener Marking Sequence

10.5 ~~Generic Torque Values~~ Bolt Torque Values for Flanged Connections

10.6 Generic Torque Values

11.0 COMMITMENTS AND REFERENCES

ch. 1

R TYPE M4.11

MIDDLE SOUTH UTILITIES SYSTEM

TORQUING DOCUMENTATION WORKSHEET WATERFORD-3

UNIC NO.	
SYSTEM NO.	
DATE	
PERFORMED BY	
CIWA	

1. FINAL TORQUE VALUE AND SOURCE:

   Final Torque Value (FTV) _____
   in-lbs/ft-lbs

   Source _____

2. EQUIPMENT:

Item	M&TE NO.	CAL. DUE DATE
_____	_____	_____
	_____	_____

3. TORQUE OR MARKING SEQUENCE AND SOURCE:

   Torque Sequence _____

   Marking Sequence _____

   Source _____

4. TORQUE INCREMENTS AND SOURCE:

	Required Fastener Torque (A)	Torque Wrench Indication/ Pump Pressure Necessary to Produce Required Fastener Torque (B)
1st Increment	_____	_____
2nd Increment	_____	_____
3rd Increment	_____	_____

> NOTE
> List additional increments as necessary in the "Comments" section.

Source _____

Comments: _____

_____

_____

Reviewed By MMS _____ Date _____

1. GENERAL

a. The average individual can safely and comfortably pull with a force of approximately 100 pounds (Figure 1). This should be taken into consideration in determining the desirability of using a torque multiplier as follows:

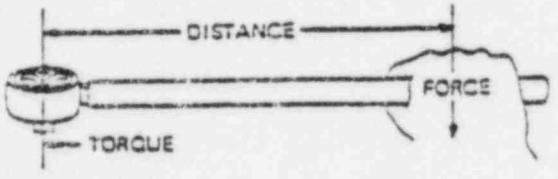


Figure 1: Torque Wrench Principles

Formula:

$T = D \times F$

Where:

T = Torque in in-lbs or ft-lbs

D = Distance or length of lever in inches or feet

F = Force in pounds

Example:

A given fastener must be tightened to a torque measurement of 600 foot-pounds. Using the formula:

$600 = D \times 100$

$D = \frac{600}{100} = 6$ feet

b. In the previous example, a torque wrench having a handle length of 6 feet would have to be used to limit the force applied by the individual to 100 pounds. If 6 feet of swing space (Figure 2) is not available, the required handle length and/or effort can be reduced by using a torque multiplier as described in section 2, Use of Williams Torque Multipliers.

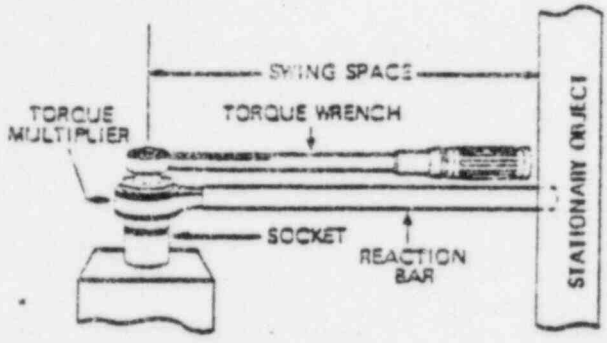


Figure 2: Swing Space

2. USE OF WILLIAMS TORQUE MULTIPLIERS

a. It is often necessary to use torque multipliers to attain the required torque for large fasteners. When torque multipliers are used, the reading of the torque wrench setting is not the actual torque exerted on the fastener. The ratio between the actual torque on the fastener and the torque shown on the torque wrench dial is determined by the "Actual Mechanical Advantage" of the multiplier as shown in Table 1.

TABLE 1: ACTUAL MECHANICAL ADVANTAGES FOR WILLIAMS TORQUE MULTIPLIERS

Model Number	Actual Mechanical Advantage
TM-750LW	3.5
TM-1000	3.5
TM-1500	3.7

b. When using a multiplier, determine the torque values as follows:

Formula for Determining Torque:

$$t = \frac{T}{AMA}$$

Where:

t = Torque in ft-lbs indicated at wrench

T = Effective torque in ft-lbs on fastener

AMA = Actual Mechanical Advantage

Example:

If 350 ft-lbs is the required torque for a nut when using the TM-750LW Multiplier:

$$\frac{350 \text{ ft-lbs}}{AMA} = \frac{350 \text{ ft-lbs}}{3.5} = 100 \text{ ft-lbs}$$

Therefore, 100 ft-lbs is the required torque wrench reading, when used with this multiplier.

c. When extreme torque values are required and space and/or manpower is limited, two or more torque multipliers may be used in tandem (Figure 3). The ratio between the actual torque on the fastener and the torque shown on the torque wrench dial is determined by the "Actual Mechanical Advantage" of the combination of multipliers as shown in Table 2.

CAUTION

Use a ratchet in the wrench arrangement when using more than one multiplier. Spring action in multiplier gear teeth could constitute a safety hazard if the workman were to release his hand hold on the wrench during the tightening process.

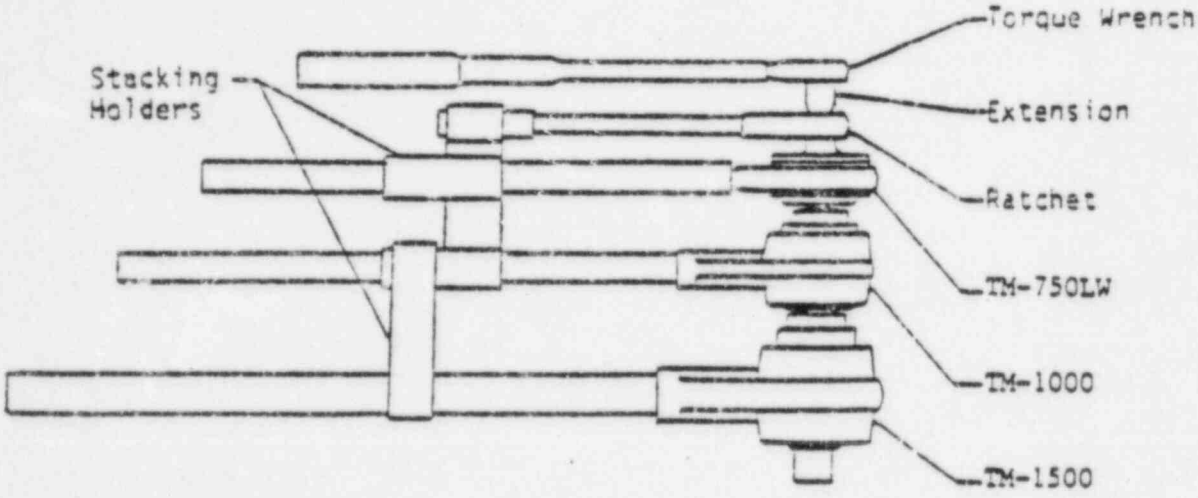


Figure 3: Williams Torque Multiplier Wrench Arrangement

TABLE 2: ACTUAL MECHANICAL ADVANTAGES FOR COMBINATIONS OF WILLIAMS TORQUE MULTIPLIERS

Combination	Actual Mechanical Advantage
TM-750LW and TM-1000	(3.5) x (3.5) or 12.25
TM-1000 and TM-1500	(3.5) x (3.7) or 12.95
TM-750LW, TM-1000 and TM-1500	(3.5) x (3.5) x (3.7) or 45.325

d. When using a combination of torque multipliers, determine the torque values as shown in Section 2.b.

CAUTION

The maximum torque on the output side of the smaller torque multiplier usually exceeds the maximum torque allowed on the input side of the larger multiplier. Do not exceed the maximum input torque values presented in Table 3.

TABLE 3: WILLIAMS TORQUE MULTIPLIER SPECIFICATIONS

Model Number	Maximum Input (ft-lbs)	Maximum Output (ft-lbs)
TM-750LW	285	1000
TM-1000	570	2000
TM-1500	1080	4000

e. When torque multipliers are used, a stationary object positioned so that all ratchet and multiplier handles (reaction bars) can react against it is required. See Figure 4 and Section 3.

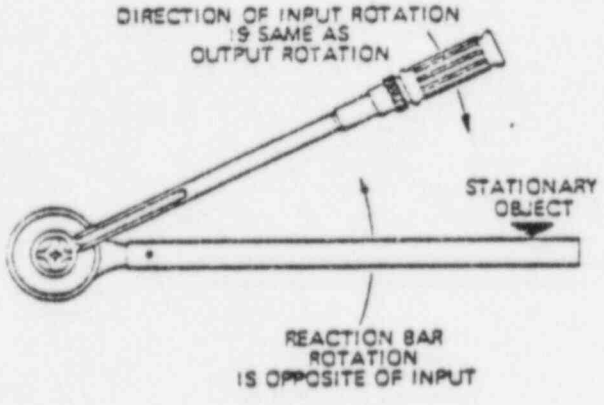


Figure 4: Typical Multiplier Operation

B. USE OF REACTION BARS

a. A reaction bar (handle attached to the torque multiplier head) is necessary to prevent the head of the torque multiplier from rotating when force is applied. The reaction bar must rest securely against a stationary object sturdy enough to withstand the force that will be generated. The amount of force that will be generated at any point along the length of the reaction bar depends upon the distance from that point to the center of the drive tang of the torque multiplier and is calculated as follows:

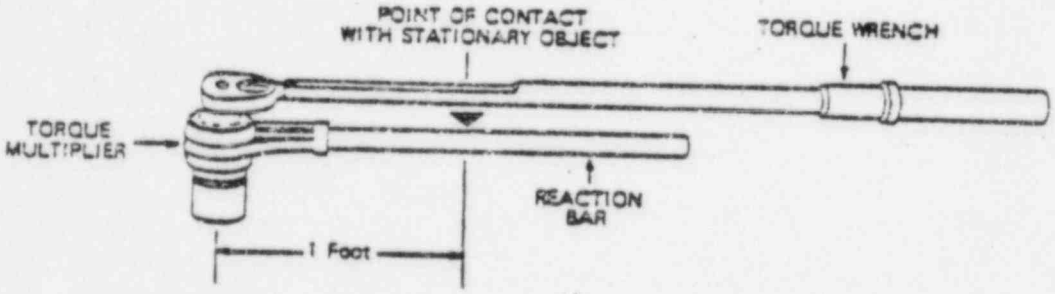


Figure 5: Reaction Bar Principles

Formula:

$F = T/D$

Where:

F = Force generated by reaction bar

T = Reaction bar torque (multiplier output minus torque wrench input)

D = Distance from point reaction bar contacts stationary object to center of drive tang of the torque multiplier

Example:

Mechanic wishes to apply 1,200 ft-lbs of torque on a fastener, the center of which is located o foot from the stationary object against which the reactio bar is resting, using a Williams TM-1000 Torque Multiplier. Per Section 2.b., torque wrench input would be:

$\frac{1200}{3.5} = 343$ ft-lbs

$T = 1200-343 = 857$ ft-lbs

$F = \frac{857}{1} = 857$ lbs

b. In the previous example, the stationary object must be capable of withstanding 857 lbs of force.

4. USE OF ADAPTERS

a. It is often necessary to use adapters with the torque wrench (Figure 6) in order to reach inaccessible bolts and nuts. When adapters are used, the reading of the torque wrench dial is not the actual torque exerted on the fastener. The ratio between the actual torque on the fastener and the torque shown on the wrench dial is determined by the length of the adapter and the location of the torque wrench handle where the pull is applied. It is very important that the pull on the torque wrench handle be concentrated as much as possible at distance B, as a shift in this length will cause considerable error in the effective torque at the end of the adapter.

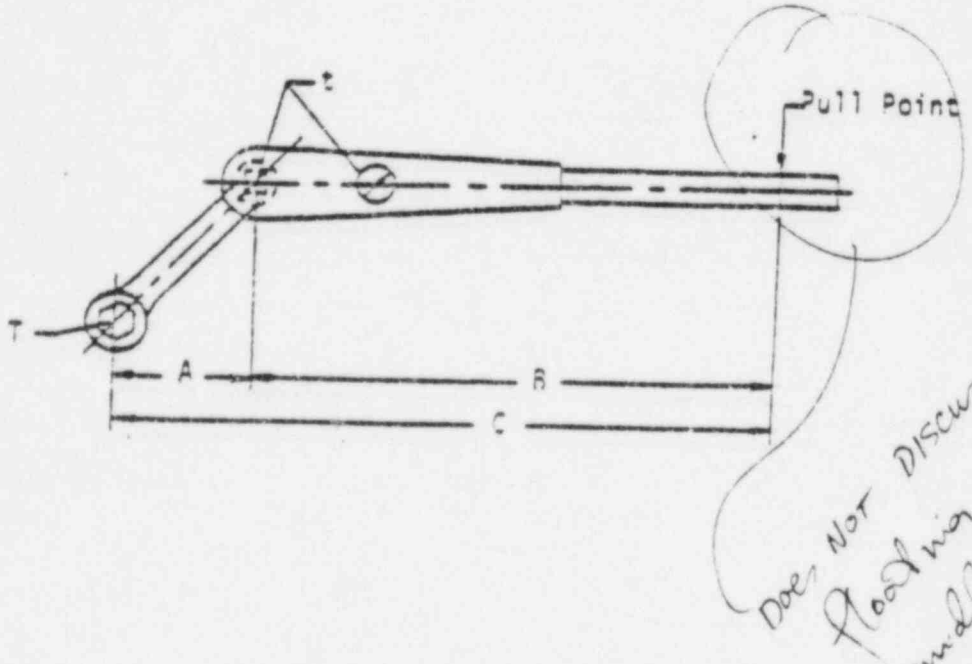


Figure 6: Torque Wrench with Adapter

Does not discuss flooding handle wrenches

Formula:

$t = T \times \frac{B}{C}$

Where:

A = Effective adapter length in feet

B = Length in feet between square drive of torque wrench and location on handle where pull is concentrated

C = Total effective length of wrench in feet: C = B + A

T = Effective torque in ft-lbs on fastener

t = Torque in ft-lbs indicated on wrench dial

Example:

If A = 1/2 ft

B = 3 ft

T = 350 ft-lbs (Torque desired on fastener)

Then $t = 350 \times \frac{3}{3 + 1/2}$

t = 300 ft-lbs (Torque indicated on wrench dial)

Note that when adapter is at right angles to the torque wrench, B = C and T = t.

NOTE

Refer to Figure 1 of this attachment for component identification unless otherwise specified.

1. PUMPING UNIT TEST

a. Remove the reservoir breather cap and verify that the oil level is just below the bottom of the fill tube. If the reservoir requires oil, fill using SAE 10 nondetergent oil. The reservoir capacity is approximately one gallon.

NOTE

Ensure that a breather cap, not a solid pipe plug, is installed in the reservoir.

b. Turn the pressure regulator knob counterclockwise until the spring pressure is relieved.

c. Connect a supply of 100-psig compressed air to the AIR INLET connection.

d. Push and hold the button on the remote control switch; then turn the regulator knob clockwise until the pump starts.

e. Verify that the pump continues to pump but that pressure does not continue to increase (when the regulator pressure is exceeded, oil will be bypassed back to the reservoir).

2. HOSE CONNECTIONS

a. Connect the hydraulic hose between the HYDRAULIC TO WRENCH connection on the control box and the hydraulic connection on the wrench.

NOTE

1. Make sure that the male tips are clean and free of dirt. 2. When the male tips have been pushed all the way in, screw the restraining collars on until they bottom. Force is not necessary but it is important that the collar be screwed on all the way or there will be a restriction of oil flow. The collar is a free fit and should almost spin on.

b. Connect the air hose between the AIR TO WRENCH connection on the control box and the air connection on the wrench.

3. POWER STROKE INSTRUCTIONS

a. The wrench power stroke will stop when the hydraulic pressure reaches the setting of the pressure regulator/relief. If this occurs at the extreme end of the stroke, the pump should be cycled and another wrench stroke started to ensure that the desired torque has been achieved.

b. The reaction block at the pivot end of the cylinder will have to reach against some fixed structure to counteract the wrench torque. Ensure that the reaction block will contact the fixed structure as flush as possible. If a fixed structure is not available, it will be necessary to use either bar stock and C-clamps, a blind flange adapter (refer to Figure 2, Use of Blind Flange Adapter), or another suitable temporary reaction structure.

c. Index marks have been provided on the lever arm and frame to indicate when the end of the stroke has been reached. Another indication of reaching the end of the stroke occurs when further motion stops and pressure rises rapidly.

d. After completing a power stroke, release the oil pressure. This will initiate the air return system, thereby retracting the cylinder piston rod and lever arm.

e. Ensure that the piston is fully retracted before starting a new stroke. During the retracting stroke, the drive pins, when full-ratcheted, will drop in the next successive pockets with an audible click. If a click is not heard, the drive pins have not engaged. The wrench, therefore, will not advance the nut through another full 30 degrees of rotation. An audible click also will not be heard if a full 30-degree stroke is not taken. This can be corrected by ratcheting the wrench manually prior to placing it on the next nut.

4. CONVERTING FROM TORQUE TO PRESSURE

a. Refer to the graphs, Figure 3, PHW 1.5 Hydraulic Wrench, or Figure 4, PHW 15 Hydraulic Wrench, and convert the desired torque value to equivalent pump pressure (psig).

5. ADJUSTING THE REGULATOR SETTING

a. Disconnect the high-pressure hydraulic hose from the hydraulic wrench.

b. Push the remote control switch button to operate the unit and check pressure reading. Adjust pressure reading as desired by turning the pressure regulator knob clockwise to increase set pressure and counterclockwise to decrease set pressure.

c. Reconnect the high-pressure hydraulic hose to the hydraulic wrench.

HYDRAULIC TORQUE WRENCH AND CONTROL BOX

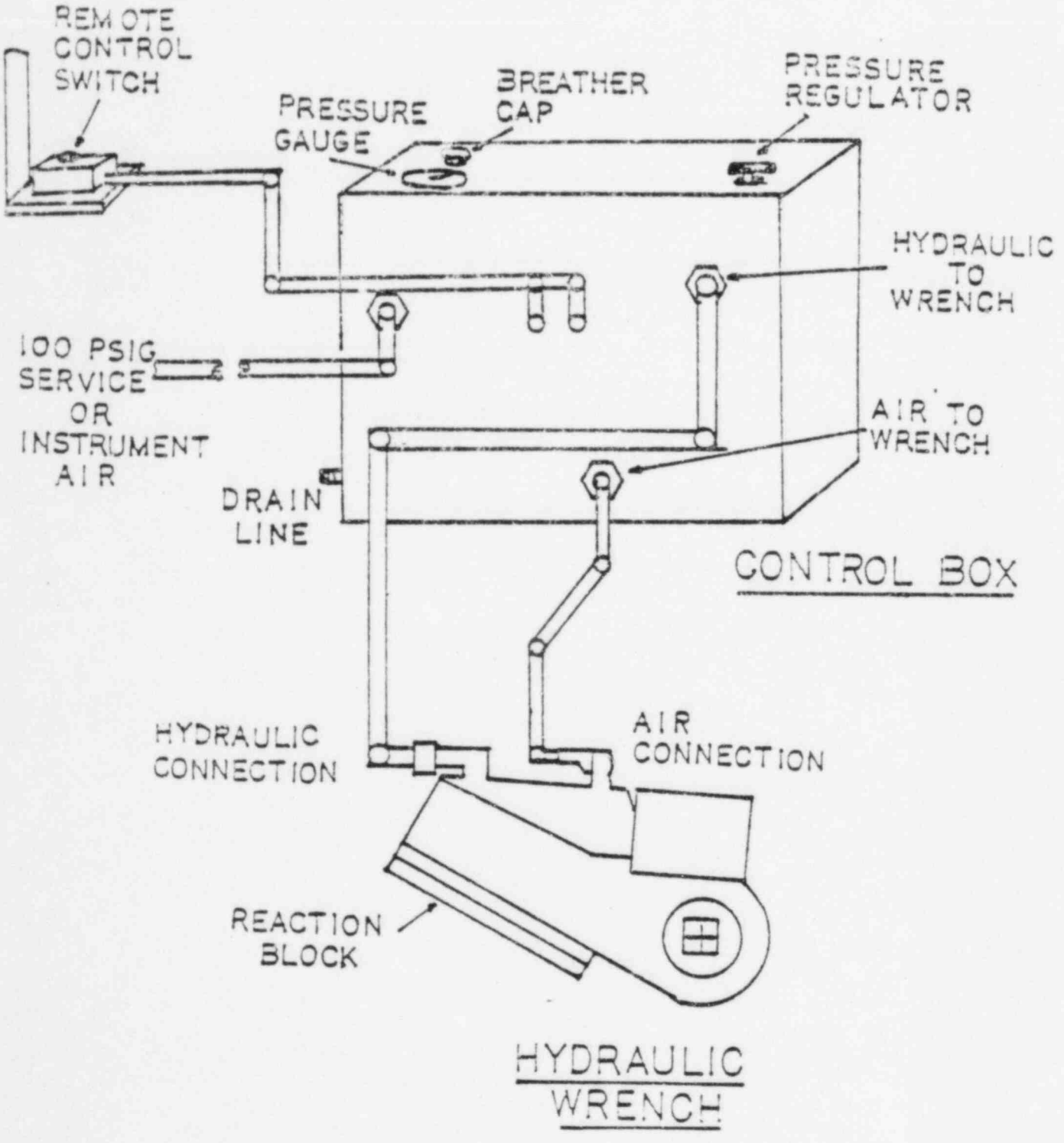
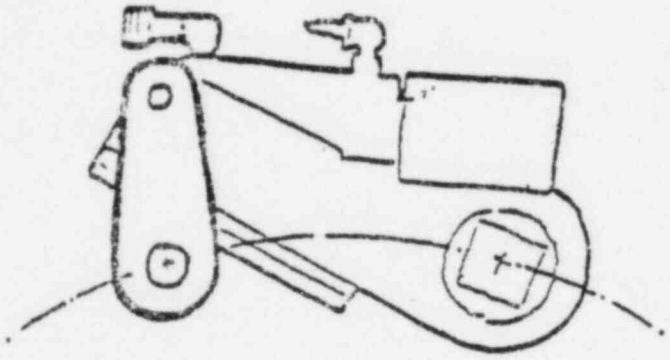
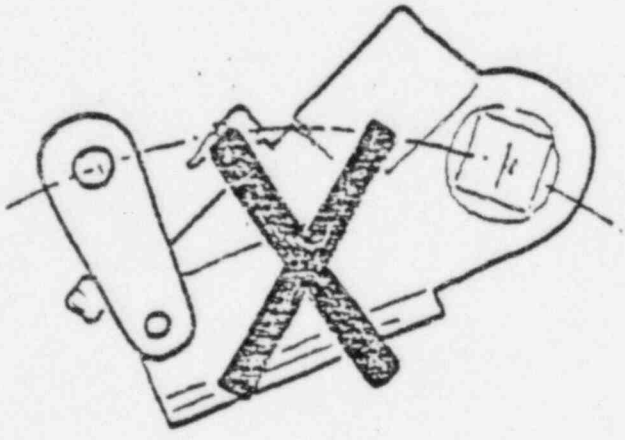


FIGURE 1

USE OF BLIND FLANGE ADAPTER



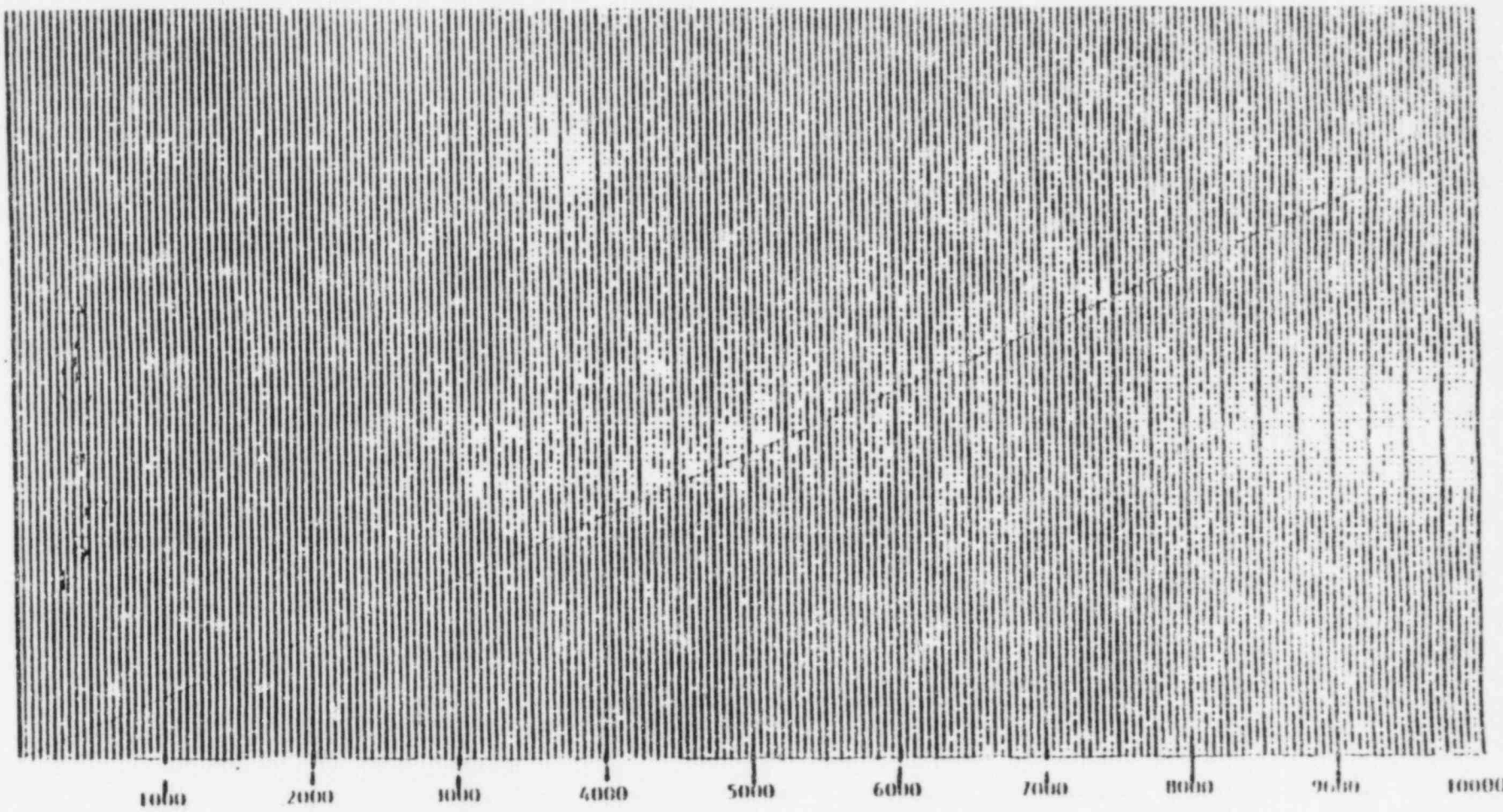
The Blind Flange Adapter must always be used in compression when torquing or detensioning.



DO NOT USE Blind Flange Adapter in tension.

FIGURE 2

PHW 1.5 HYDRAULIC WINCH 0-1,640 FT-LBS



PRESSURE (PSIG)

FIGURE 3

PHW 15 HYDRAULIC WRENCH 0-16,200 FT-LBS

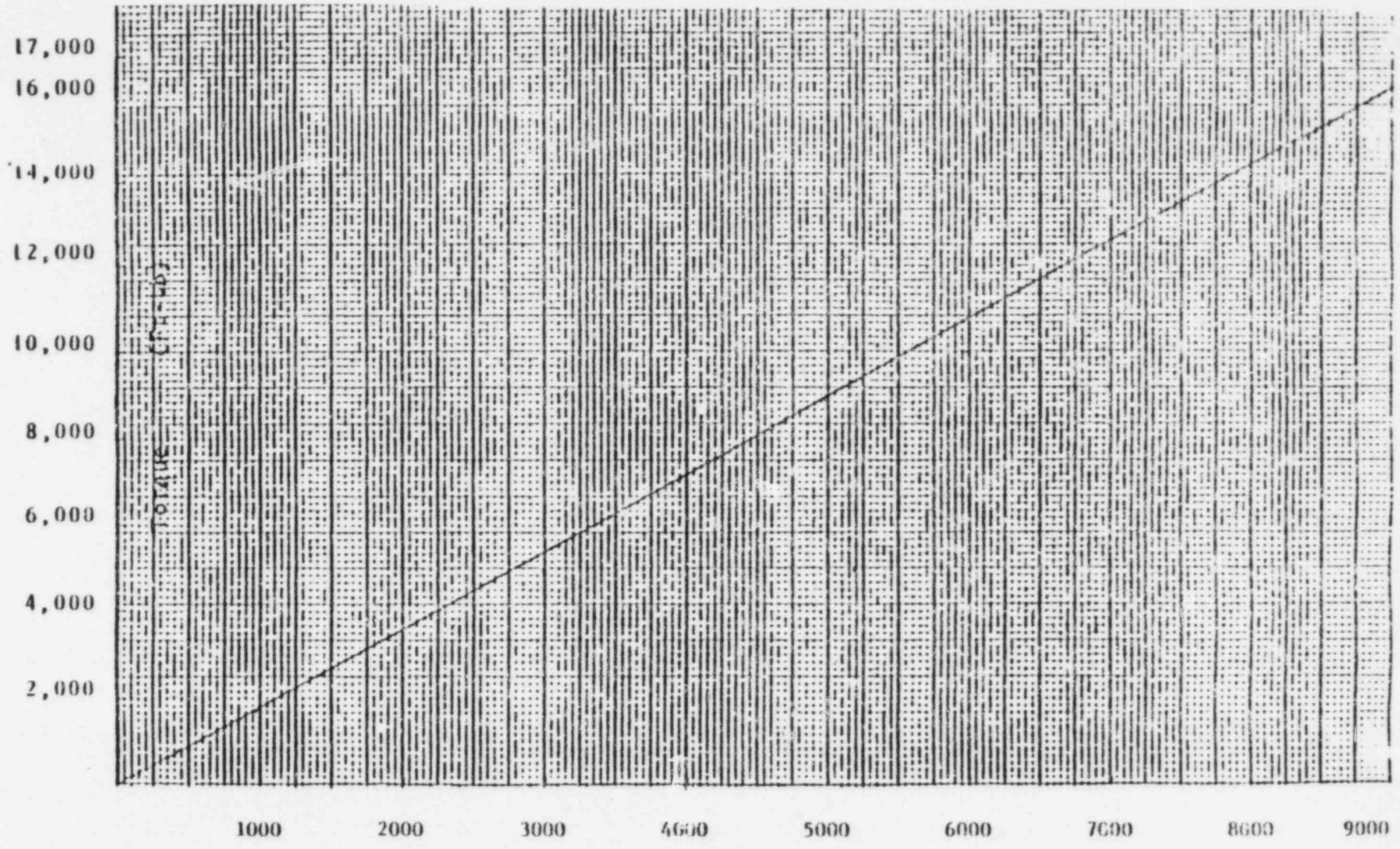


FIGURE 4

FASTENER MARKING SEQUENCE

NO. OF HOLES	MARKING SEQUENCE (MARK FROM TOP CENTER STUD CLOCKWISE)
4	1-4-2-3
6	1-6-4-2-5-3
8	1-6-4-7-2-5-3-8
10	1-6-9-4-7-2-5-10-3-8
12	1-6-9-4-7-11-2-5-10-3-8-12
14	1-9-6-13-4-8-12-2-10-5-14-3-7-11
16	1-9-6-13-4-11-8-15-2-10-5-14-3-12-7-16
18	1-16-6-18-9-4-13-7-11-2-15-5-17-10-3-14-8-12
20	1-19-15-8-11-4-17-13-6-9-2-20-16-7-12-3-18-14-5-10
24	1-9-18-6-14-21-4-12-19-8-23-15-2-10-17-5-13-22-3-11-20-7-24-16
28	1-12-15-25-7-21-17-4-13-23-9-6-27-20-2-11-16-26-8-22-18-3-14-24-10-5-28-19
32	1-19-15-23-8-28-11-31-4-17-13-22-6-26-9-29-2-20-16-24-7-27-12-32-3-18-14-21-5-25-10-30
36	1-27-15-19-36-23-8-32-11-4-17-21-25-13-6-30-9-33-2-28-16-20-35-24-7-31-12-3-18-22-26-14-5-29-10-34

TORQUE TOROUE VALUES FOR FLANGED CONNECTIONS

REFERENCES: FCR's - MP-319, 345, 382

These values were calculated using required bolt tension based upon 50% of the minimum yield strength of the bolt material and the coefficient of friction for the nickel/graphite lubricant.

TOROUE VALUES + 5% FT. LBS.

BOLT SIZE	ASTM A-307.B	ASTM A-193.B-7	ASTM A-193.B-8
3/8"	6.5	20	5.4
1/2"	15.5	45	13
5/8"	30	90	25
3/4"	55	160	45
7/8"	85	250	70
1"	130	370	105
1 1/8"	180	515	150
1 1/4"	255	730	210
1 3/8"	330	930	265
1 1/2"	435	1235	350
1 5/8"	555	1560	445
1 3/4"	685	1910	545
1 7/8"	855	2395	685
2"	1025	2840	810
2 1/4"	1500	4180	1195
2 1/2"	2050	5645	1615
2 3/4"	2770	7680	2195
3"	3565	9785	2795

GENERIC TORQUE VALUES*

Fastener	Type	Body Size of Outside Diameter																				
		1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2	1 5/8	1 3/4	1 7/8	2	2 1/4	2 1/2	2 3/4	3
	SAE 2 STEEL	6	12	20	32	47	69	96	155	206	310	480	675	900	1100	1470	1900	2360	2750	3450	4400	7350	9500
	SAE 5 STEEL	10	19	33	54	78	114	154	257	382	587	794	1105	1500	1775	2425	3150	4200	4550	6550	7175	13,000	16,000
	SAE 7 STEEL	13	25	44	71	110	159	215	360	570	840	1325	1825	2500	3000	4000	5300	7000	7500	11,000	15,500	22,000	29,000
	SAE 8 STEEL	14	29	47	78	119	169	230	380	600	900	1930	1915	2650	3200	4400	5650	7600	8200	12,000	17,000	23,000	29,000
	Socket Head Cap Screws	16	33	54	84	125	180	250	400	640	970	1520	2130	2850	3450	4700	6100	8200	8700	13,000	17,000	28,000	31,000
	Socket Set Screws	**70	**140	18	29	43	63	100	146														

NOTES

1) These values are for lubricated fasteners.
2) IE fastener is not listed on the table, refer to ~~Snap-on Tools Booklet Form SS-477F, 86~~ APPLICABLE VENDORS/REPAIR MANUAL
*3) Snap-on Tools Corporation Form SS-477F-10M-B.

**4) Inch-Pounds.

MX-6-011 Revision 0
Change 1
29
29
Attachment 10.6 (1 of 1)

MIDDLE SOUTH UTILITIES SYSTEM

LOUISIANA POWER & LIGHT CO.

WATERFORD 3

MISSING INFORMATION LIST

PROCEDURE NO. MM-6-011 PROCEDURE TITLE General Torquing & Detensioning

ITEM NO.	ITEM	AFFECTED PARAGRAPH	CLEARED DATE	CLEARED INITIAL
1	Need Central Records No.	2.3.4		
2	Need Central Record No.	2.4.5		
3	Need Central Record No.	2.4.6		
4	Section 11.0 needs 4 Z# central record numbers	11.0		
~~5~~ 2-17	~~Need Central Records #~~ DS 2-17-82	~~2.7~~ DS 2-17-82		

ALL MISSING INFORMATION ON THIS LIST HAS BEEN CLEARED

ASSIGNED AUTHOR

RTYPE
A2.17

WATERFORD 3

DOCUMENT REVIEW CHECKLIST

☑ MANUAL ☐ DRAWING ☐ OTHER _____

DOCUMENT ACCESS NUMBER 4570000468

TITLE LIMITORQUE INSTRUCTION AND MAINTENANCE MANUAL

PURCHASE ORDER NO. NY-403453 GE Switchgear

VENDOR L 2000

REVISION 0

REVISION DATE _____

DOCUMENT REVIEWED FOR COMPLETENESS (ALL PAGES, ALL SECTIONS INTACT) YES NO
YES/NO

DOCUMENT REVIEWED FOR COMPONENT APPLICABILITY YES NO
YES/NO

SAFETY RELATED YES NO
YES/NO

DISCREPANCIES NOTED

Copies 1 & 002 should be deleted as this copy (003) contains that and more information

REVIEWER SIGNATURE W E Ball DATE 8-21-81

TITLE "ME" PROCEDURE PRODUCTION SUPVSR

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LP&L W-3 RECORDS

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RECORD OF REVISION

DOCUMENT ACCESS NUMBER: [illegible]

TITLE: Limitorque Type SMB Instruction & Maintenance Manual

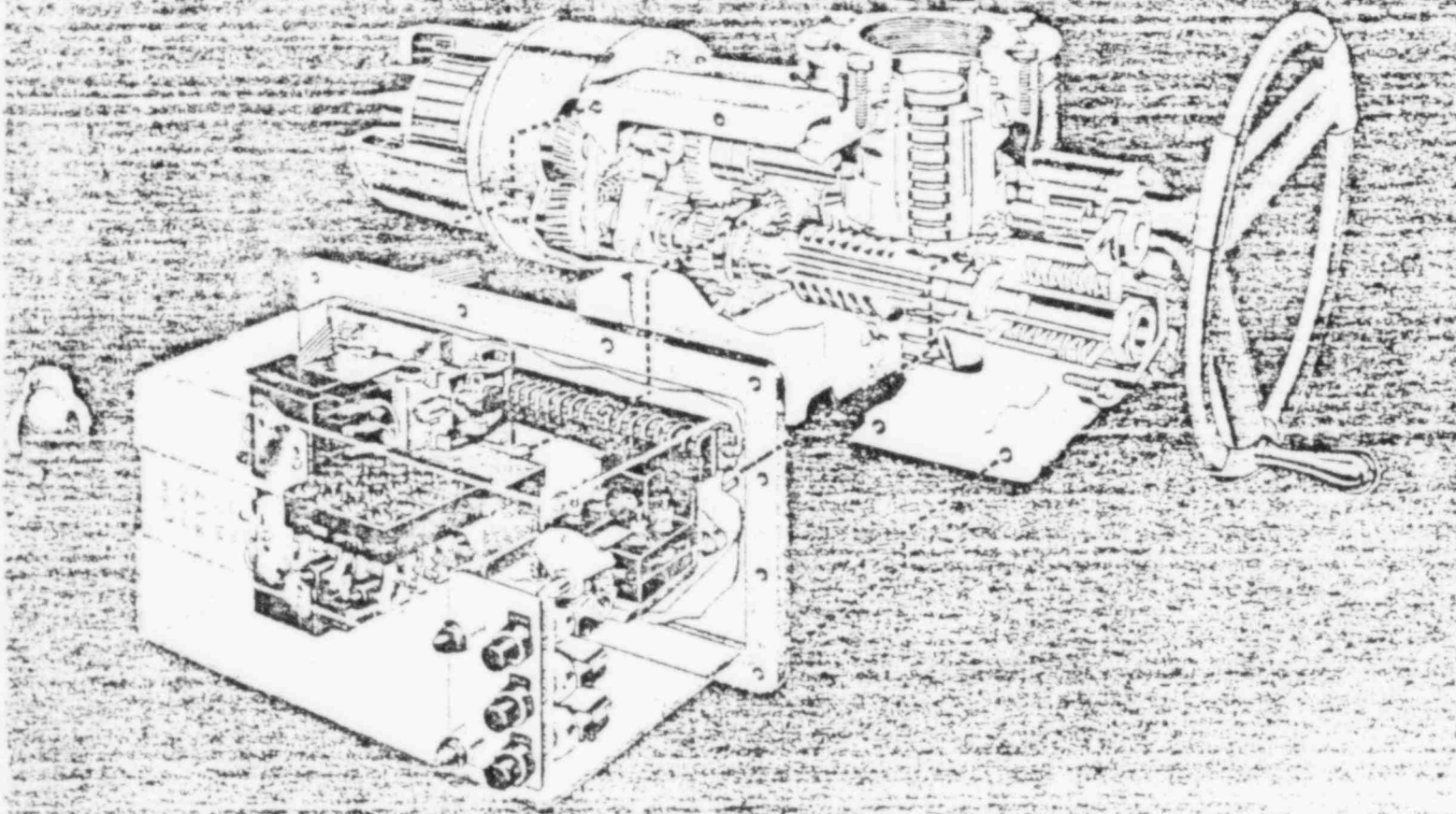
REV. NO.	REV. DATE	DESCRIPTION OF CHANGE	REVIEW DATE	INITIAL

PROCEDURE REFERENCE SHEET

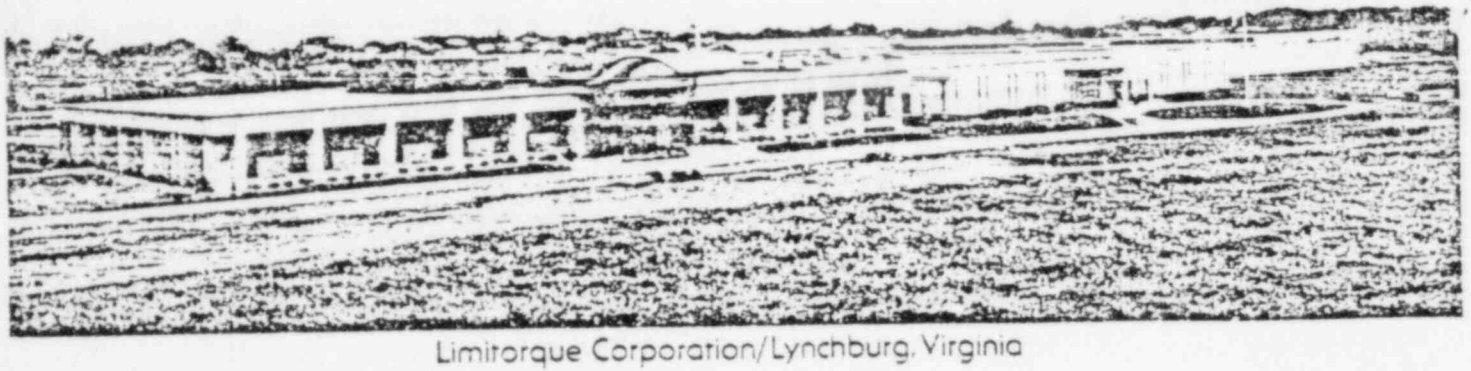
THE PROCEDURES LISTED BELOW REFERENCE THIS MANUAL FOR USE IN ACCOMPLISHING AN OPERATIONAL OR MAINTENANCE ACTIVITY. ANY REVISION TO THIS MANUAL REQUIRES THAT EACH PROCEDURE BE REVIEWED FOR CONFLICT PRIOR TO ACTUAL MANUAL CHANGE.

PROCEDURE NUMBER	PROCEDURE NUMBER	PROCEDURE NUMBER

LIMITORQUE
TYPE SMB
INSTRUCTION AND MAINTENANCE MANUAL



A PRODUCT OF LIMITORQUE® CORPORATION



Limitorque Corporation/Lynchburg, Virginia

Your Limitorque Valve Control...

Limitorque is the most advanced valve control on the market — the result of many years of constant improvement and development. This booklet has been prepared to help you obtain the most benefit and use from your Limitorque valve controls. It contains instructions on the installation and maintenance of these units, plus helpful suggestions enabling you to become thoroughly familiar with the location and proper use of operating controls. Before you do anything, be sure to read this booklet through at least once, then always keep it handy for ready reference.

Limitorque controls the opening and closing travel of the valve and limits the torque and thrust loads with its torque limit switch. As a result, all valve operating parts are protected from overload, improper seating and foreign obstructions.

Limitorque controllers may be mounted on any size valve in almost any position or location. Readily adaptable to existing equipment, Limitorque can be actuated by electricity, hydraulic pressure, air or natural gas.

Where to Find Information

INSTALLATION TIPS

Do:

1. Do store crated units under shelter. Your Limitorque is not weatherproof until properly installed.

2. Do cut power off before opening or replacing limit switch compartment cover.

3. Do check limit switch operation in conjunction with motor rotation. If motor is turning in wrong direction interchange motor leads.

4. Do mount motors on horizontal plane, if possible. It is preferred to keep motor or limit switch compartment from hanging down. This prevents head of grease being against motor or switch seals.

5. Do connect space heaters if unit is to be stored in a damp place prior to installation.

6. Do keep valve stem clean and properly lubricated.

7. Do set up periodic operating schedule for Limitorque control if valve is infrequently used.

8. Do lubricate drive sleeve top bearing every six months, using grease gun on pressure fitting in housing cover.

9. Do keep geared limit and torque switch contacts clean. Use carbon tetrachloride or other solvent on lint-free cloth.

10. Do keep limit switch compartment clean and dry.

11. Do be sure area is clean before disassembling Limitorque. Clean all parts and housing before re-assembly.

12. Do apply fresh, clean lubricant after reassembly.

13. Do reset geared limit switch before motor operation if Limitorque has been either dismantled or removed from valve.

14. Do replace whole limit switch gear box rather than attempt repairs in field.

15. Do replace moulded plastic conduit top protectors (installed for shipping and storage only) with pipe plugs when installation wiring is completed.

16. Do check valve stem travel before mounting stem protection cover on rising stem valves. All stems should have protection cover.

17. Do check for proper direction of rotation of motor. If valve closes when open button is pushed the motor may have to be electrically reversed.

18. Do distinguish between "normally open" and "normally closed" terminals on geared limit switch micro switches (when used) when wiring control circuit.

19. Do keep armature clean and periodically check brushes for proper contact and wear when D.C. motors are employed.

20. Do remember that D.C. motor speed is not constant but will fluctuate widely with the load applied.

21. Do clean limit switch cover thoroughly and apply thin coat of grease on bearing surfaces before mounting on explosion proof Limitorque.

22. Do check and replace damaged limit switch cover gasket before securing on weatherproof Limitorque.

23. Do refer to parts list when ordering replacement or spare parts.
Give nameplate data:

Unit Type	Order No.
Unit Size	Serial No.

24. Do check to be sure stem nut is secured tightly by locking nut and that top thread of lock nut is crimped or staked in two places.

Don't:

1. Don't force declutch lever into motor operation position. Lever returns to this position automatically when motor is energized.

2. Don't try to force declutch lever from motor operation position to hand operation position.

3. Don't use abrasive cloth or paper to clean silver contacts of geared limit switch and torque switch. Contacts should be burnished.

4. Don't depress declutch lever during motor operation to stop valve travel, except in emergency on SMB000 and SMB00.

5. Don't torque seat plug valves or butterfly valves unless valve manufacturer is consulted.

6. Don't use cheater on handwheel.

7. Don't plug motor — by alternately starting and stopping motor to open or close a valve too tight for normal operation.

8. Don't use oversize motor overload heaters — instead look for cause of overloading.

9. Don't reset torque switch seating heavier than maximum recommended by factory.

10. Don't run "plug" type valve against stop as damage may result to valve.

11. Don't attempt to remove either spring cartridge cap or housing cover from Limitorque while valve is torque seated. Always back valve off seat several handwheel turns before dismantling unit.

12. Don't attempt to set limit switches without first disconnecting control and power circuits.

13. Don't motor operate valve withhout first checking limit switch setting.

Trouble-Shooting:

If geared limit switch fails to stop valve travel, check the following:

A. Control wiring and motor reversing contactor.
B. Geared limit switch setting.
C. Setting rod to see that it has been backed off after each side of switch has been set.
D. Remove limit switch gear box cover and inspect for damaged or broken gear teeth.

If unable to operate Limitorque by motor:

A. Check both motor power and control circuits for supply and continuity.
B. Compare supply voltage with motor and controller nameplate rating. If O.K., then check motor amperage load.
C. If stalled motor is indicated, shut off power and operate Limitorque by handwheel to move valve.

Excessive handwheel effort can indicate the following:

A. Improperly lubricated or damaged valve stem.
B. Valve packing gland too tight.
C. Improperly lubricated valve.
D. Stem nut too tight on valve stem.
E. Faulty or damaged valve or parts.

TYPICAL OPERATION
SMB UNITS

Description of Motor Operation:

The motors used on the Limitorque valve controls are high starting torque, totally enclosed motors. They are furnished in weatherproof, explosion proof or submersible enclosures. All motors are furnished with ball bearings and provided with grease seals. No lubrication of these motors is necessary since they are lubricated at the factory for lifetime operation. All 3 phase AC motors are of the squirrel cage design and DC motors are compound wound.

Since the operation of the Limitorque valve control is basically the same for all SMB operators the following general description of the motor operation is applicable. Any of the parts drawings may be referred to in following this description. Although the various part numbers will differ for each size operator, for the purpose of explanation we will refer to the parts list drawing.*

The electric motor has a helical pinion mounted on its shaft extension. This pinion, pc. #40, drives the worm shaft clutch gear pc. #41 which is engaged with pc. #50, the worm shaft clutch. This piece is splined to the worm shaft, pc. #43. Piece #53, the worm, is splined to the worm shaft, pc. #43. Piece #53, the worm, is splined to the worm shaft and when it is rotated it turns pc. #16, the worm gear. The worm gear has two lugs cast onto the top portion which engages the two lugs on the drive sleeve, pc. #11. These lugs are spaced so that when the worm gear begins to turn during motor operation there is a certain amount of lost motion before the lugs engage and cause the hammer blow effect within the operator.

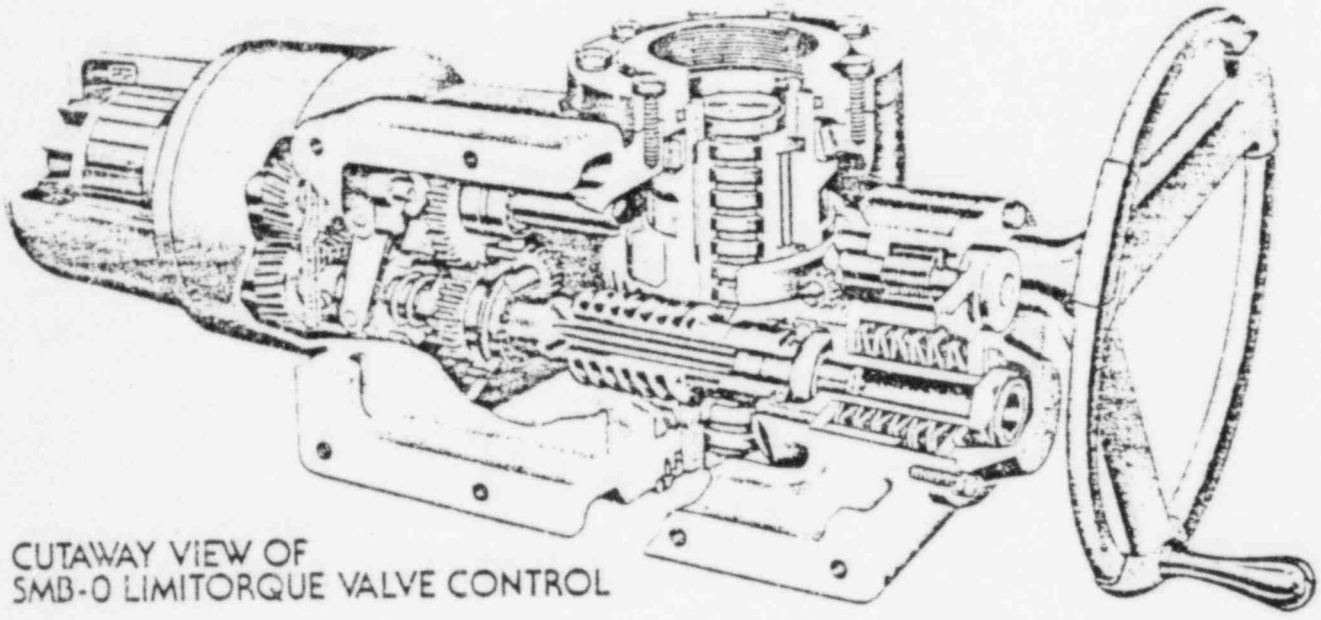
As soon as the worm gear lugs engage, the drive sleeve being splined internally with pc. #20, the stem nut, causes the stem nut to rotate and open or close the threaded stem of the valve. The stem nut is threaded to fit the thread of any rising stem valve. In the case of non-rising stem valves or where the electric operator is mounted in tandem with an additional gear drive, the stem nut, pc. #20, is merely bored and keyed to fit the shaft.

The thrust developed by a Limitorque valve control is absorbed by the heavy duty thrust bearings on the top and bottom of the main drive sleeve. As the Limitorque valve control develops greater torque, when seating the valve, the worm slides axially along the splines of the worm shaft and compresses the belleville springs, pc. #56, which is the torque spring. These are calibrated springs and for every increment of compression for a given size unit a certain predetermined amount of torque is developed. The torque switch is mechanically actuated by the worm. When the worm moves back a preset distance and develops the determined amount of torque output required, the torque switch operates and a pair of electrical contacts, which are wired into the motor control circuit, interrupts the circuit and stops the motor at this point.

The geared limit switch, pc. #105, is directly geared to the worm shaft and is in step at all times with the movement of the Limitorque valve control. It cannot slip since there are no belts or other friction devices used in its operation. Once the geared limit switch is set to trip at its proper position of valve travel it will trip at the same point every time. See instructions on how to set the geared limit switch.

Generally, the torque switch is wired into the motor control circuit to stop the operator in a full closed position of any rising stem type of operation and the geared limit switch is wired into the motor control circuit to stop the operator at the full open position. In the case of most 90° turn valves and sluice gates the geared limit switch is wired into the motor control circuit to stop the operation at both the full open and full close position of the valve. The torque switch is wired in series with the geared limit switch in both directions so that in the event a mechanical overload occurs the torque switch will open and cause the motor to stop. Check the wiring diagram of the actual installation to determine the correct wiring connections to be made for the torque switch and geared limit switch.

*Shown on page 22 (SMB-0 through SMB-4)



CUTAWAY VIEW OF
SMB-0 LIMITORQUE VALVE CONTROL

Description of Hand Operation:

In the event of power failure a handwheel is provided for emergency hand operation of the Limitorque valve control. The SMB type of operator has an automatic handwheel declutching arrangement. In order to hand operate the type SMB operator the declutch lever is pulled downward. This mechanically disconnects the electric motor from the handwheel through the clutch assembly. In the case of the SMB-000 and SMB-00 (refer to page 18), the clutch ring, pc. #28, and clutch keys, pc. #14, are moved upward until the clutch keys engage with the lugs on the bottom of the handwheel. Where the handwheel is side mounted on the SMB-00 (refer to page 19), the clutch keys engage the lugs on the bottom of the bevel gear pc. #100.

This assembly is held in this position by trippers which are illustrated on the parts drawing. The operator will remain in hand operation indefinitely until the electric motor is energized and the tripper cams mounted on the worm shaft cause the trippers to release the clutch ring and clutch keys from their hand position. This is an automatic feature of the Limitorque valve control.

This declutching action is similar in all the larger size SMB operators. Referring to the parts drawing for the SMB-0, it should be noted that when the declutch lever is depressed, the declutch lever shaft causes the declutch fork to push the worm shaft clutch out of engagement with the motor helical gearing and into engagement with the handwheel clutch pinion. The worm shaft clutch is locked in this position by the trippers. Therefore, when the handwheel is rotated, the handwheel gear turns the handwheel clutch pinion and in turn the worm shaft, putting the Limitorque operator into motion.

As soon as the electric motor is energized, the tripper pins, which are part of the worm shaft clutch gear, cause the trippers to be released allowing the worm shaft clutch to be released from hand operation and engage in motor operation.

In all cases with the SMB operator, when the handwheel is turned it does not rotate the motor. Similarly, when the motor is in operation the handwheel does not turn.

TWO TRAIN GEARED LIMIT SWITCH-ROTOR TYPE

Procedure for Setting:

The two train geared limit switch (rotor type) employs two rotary drum switches, each having four contacts. When the rotor is properly set to trip at the desired posi- on, two of these contacts open electric circuits and two contacts close electric circuits. Generally, one rotor is set to trip at the full open position of the valve, and the other rotor is set to trip at the full close position of the valve. Each drum switch may be adjusted independently of the other.

One circuit on the one drum is used to open the "open" holding coil circuit of the motor controller and another circuit of the drum is used to operate the "open" indicating light for the valve.

On the other drum, one circuit is used to control the "closed" indicating light, and another circuit may be used to open the "close" holding coil circuit of the motor controller. Please refer to the wiring diagram assigned for the actual application and circuitry to be used. The wiring diagram may be furnished as part of the Limitorque valve control, or may be furnished by the contractor who supplies the motor control and pushbutton station equipment.

In order to set the geared limit switches to trip at any desired position, the following procedure should be observed:

1. Be certain all electric power is turned off.

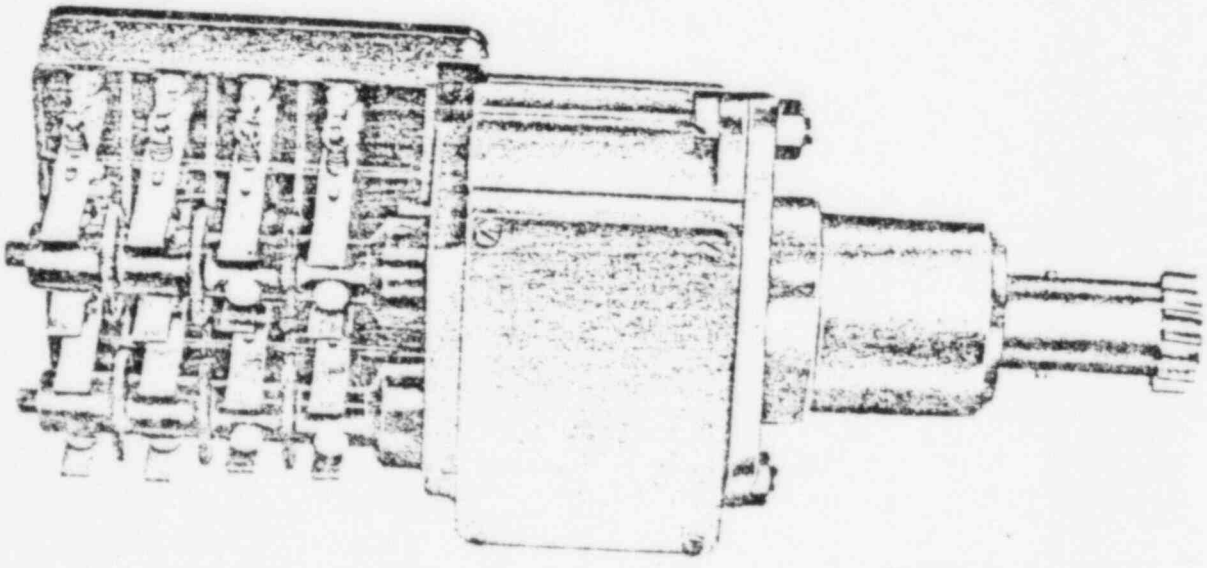
2. Use the handwheel to manually open the valve, and note direction of rotation of pc. #42 Intermittent Gear Shaft over the rotor to be set. When the valve is full open, close the valve slightly to allow for coast of moving parts.

3. Turn pc. #48 clockwise with a sc driver until it reaches a stop position.

4. If the rotor to be set has not turned to open the contacts which are to open at this position, insert screwdrive pc. #42 and turn in the same directio noted previously until pc. #49 turns opens the contacts to be set. If the ro pc. #49 has turned so that the cont are already open, turn pc. #42 in opposite direction as previously noted the contacts close. Then, turn pc. #42 sli ly in the same direction as originally no until the contacts open.

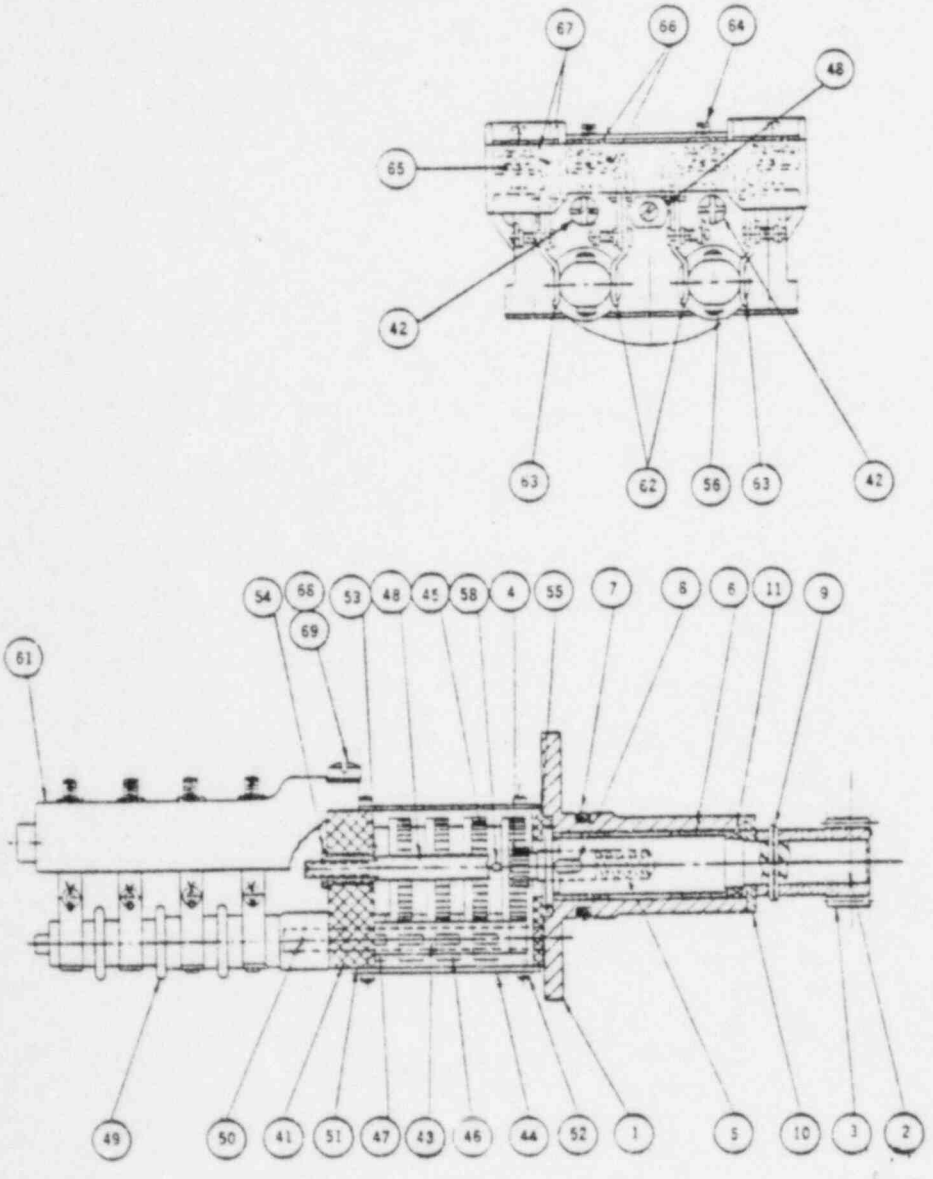
5. The rotor is now set at the correct p tion so that the contacts open. Back off pc. #48 until it stops. Again place scre driver on pc. #42 to insure that it is ti and will not rotate. (Do not force.)

6. The same procedure should be f lowed for the other rotor adjustm closing the valve completely to tripping position of the other rotor.



TWO TRAIN
GEARED LIMIT SWITCH - ROTOR TYPE

TWO TRAIN GEARED LIMIT SWITCH-ROTOR TYPE



01-472-0006-3

PC NO	NO REQD	DESCRIPTION
1	1	CARTRIDGE
2	1	DRIVE SLEEVE & SHAFT
3	1	DRIVE PINION
4	1	DRIVE PINION (SECONDARY)
5	1	DECLUTCH SPRING
6	2	BUSHING
7	1	O -RING #6027-21
8	1	PIN
9	1	GROOVE PIN ⅛ Ø x 1" LG.
10	1	WASHER
11	1	OIL SEAL
41	1	GEAR FRAME
42	2	INTER. GEAR SHAFT
43	2	INTER. PINION SHAFT
44	2	G.L. FRAME COVER
45	8	INTERMITTENT GEAR
46	6	INTERMITTENT PINION
47	2	STEM SPUR PINION
48	1	SET ROD
49	2	ROTOR
50	2	GROOVE PIN ⅛ Ø x ¾" LG.
51	2	COVER GASKET
52	8	#6-32 x ⅜ LG. FILL. HD. MACH. SCR.
53	1	O -RING #1820-3
54	1	SETTING ROD BUSHING
55	1	GASKET, GEAR FRAME
56	8	INSERT (ROTOR)
57	2	"O" -RING (FOR INTER. GEAR SHAFT PC. 42)
58	2	GROOVE PIN ⅛ Ø x 1" LG.
61	1	FINGER BASE
62	8	R.H. FINGER ASSY.
63	8	L.H. FINGER ASSY.
64	16	#10-32 x 1" LG. HEX. HD. C.S.
65	16	#10 LOCKWASHER
66	32	#10-32 HEX. NUT
67	32	#10 SW'B Ø WASHER
68	2	#¼-20 x ⅜ LG. FIL. HD. C.S.
69	2	¼" INT. TOOTH LOCKWASHER

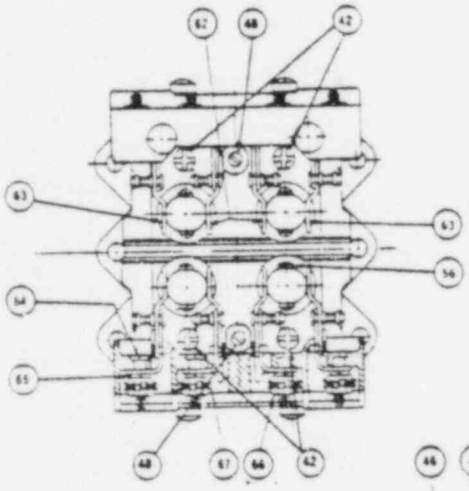
FOUR TRAIN GEARED LIMIT SWITCH-ROTOR TYPE

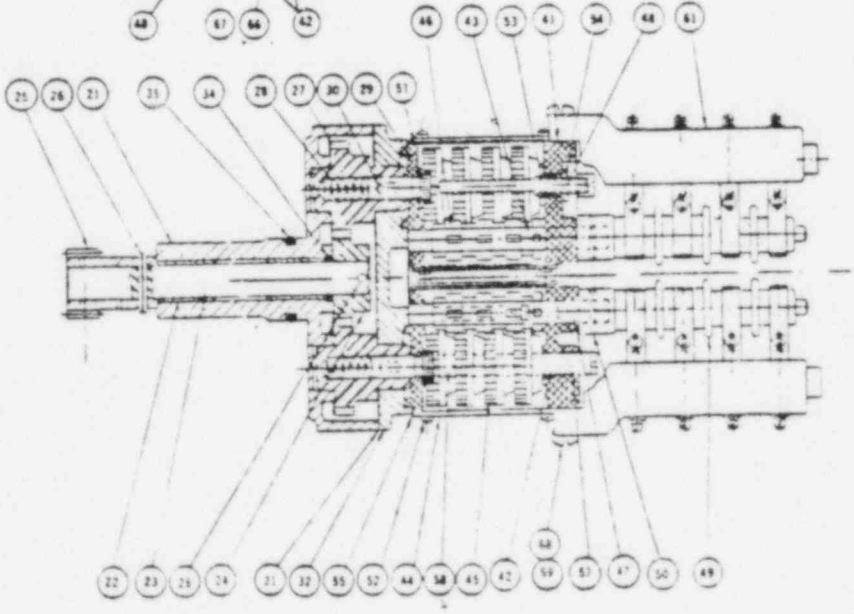
Procedure for Setting:

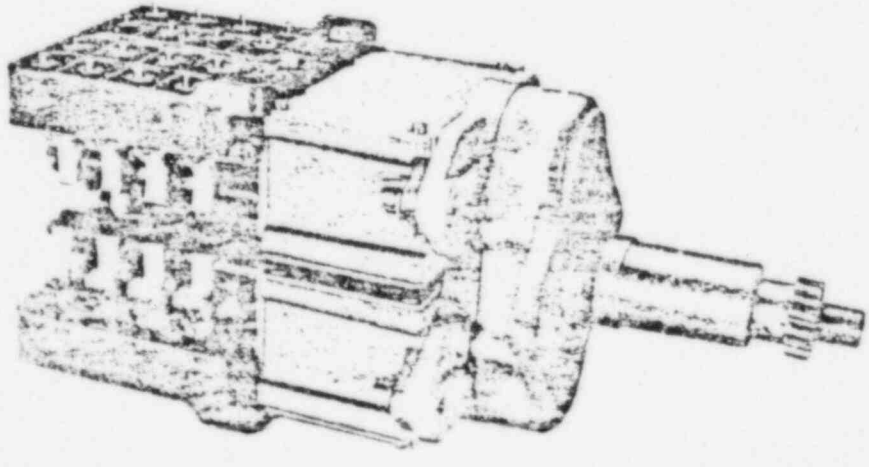
The four train geared limit switch (Rotor type) employs four rotary drum switches, each having four contacts. When the rotor is properly set to trip at the desired position, two of these contacts open and two close electric circuits. Generally, one rotor is set to trip at full open position of the valve and one rotor is set to trip at full close position of the valve. The other two rotors are set at some intermediate position, depending on the requirements of the project.

To set the switches of a four train rotor type switch, follow the same procedure as described for the two train rotor type switch. The upper setting rod pc. #48 allows adjustment of the two adjacent upper rotors and lower setting rod pc. #48 allows adjustment of the two adjacent lower rotors.

PC NO	NO REQD	DESCRIPTION
21	1	CARTRIDGE
22	2	OILITE BUSHING
23	1	DRIVE SHAFT
24	1	DRIVE PINION (INTERNAL)
25	1	HELICAL PINION
26	2	GROOVE PIN ⅛ Ø x 1" LG.
27	2	DRIVE SLEEVE & GEAR
28	2	DECLUTCH SPRING
29	2	DRIVE PINION SPUR
30	2	PIN ⅛ Ø x 11/16 LG.
31	1	CARTRIDGE GASKET
32	1	CARTRIDGE MTG. PLATE
33	4	#¼-20 x ⅝ LG. SOC. HD. C.S.
34	1	"O"-RING #6227-11
35	1	"O"-RING #6227-21
36	4	#5/16-18 x ⅝" FILL. HD. CAP SCREW & LW.
41	2	GEAR FRAME
42	4	INTER. GEAR SHAFT
43	4	INTER. PINION SHAFT
44	4	G.L. FRAME COVER
45	16	INTERMITTENT GEAR
46	12	INTERMITTENT PINION
47	4	STEM SPUR PINION
48	2	SET ROD
49	4	ROTOR
50	4	GROOVE PIN ⅛ Ø x ¾" LG.
51	4	COVER GASKET
52	16	#6-32 x ¼" LG. FILL. HD. M.S.
53	2	"O"-RING #1820-3
54	2	SETTING ROD BUSHING
55	2	GASKET, GEAR FRAME
56	16	INSERT (ROTOR)
57	2	"O"-RING #1820-5
58	2	GROOVE PIN ⅛ Ø x 1" LG.
61	2	FINGER BASE
62	16	R.H. FINGER ASSY.
63	16	L.H. FINGER ASSY.
64	32	#10-32 x 1" LG. HEX. HD. C.S.
65	32	#10 LOCKWASHER
66	64	#10-32 HEX NUT
67	64	#10 SWBD WASHER
68	4	#¼-20 x ⅜ FILL. HD. C.S.
69	4	¼" INT. TOOTH LOCKWASHER



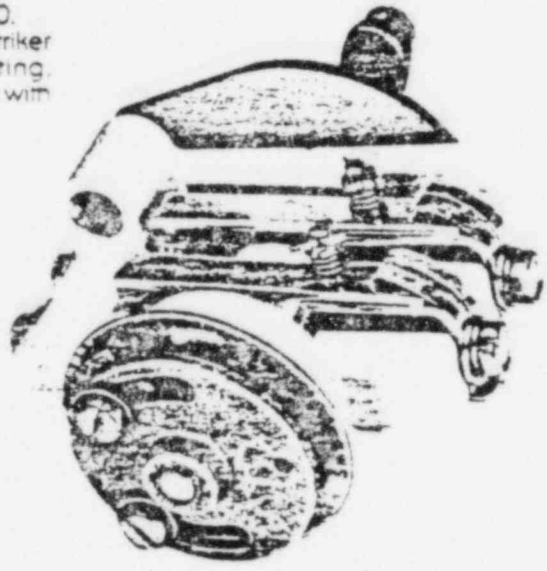


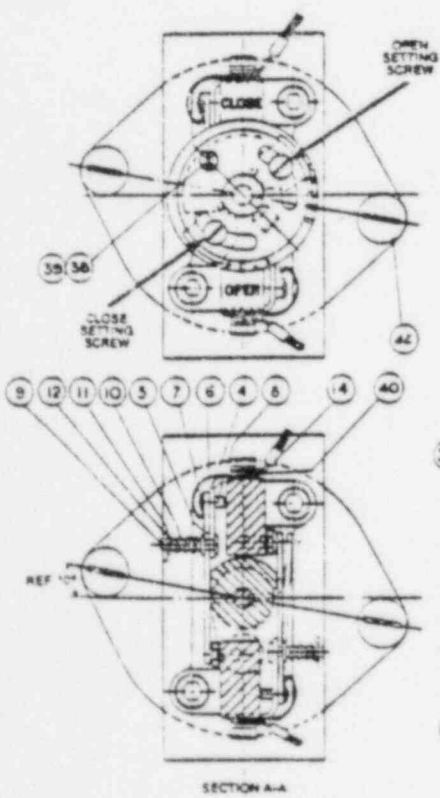


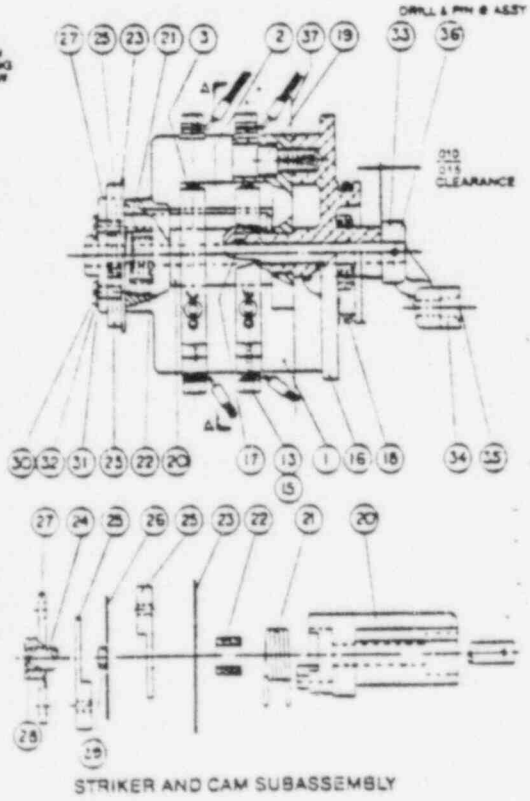
SMB-000
DOUBLE TORQUE SWITCH

Procedure for Setting:

1. Torque setting must be made with switch mounted in Limitorque.
2. Make sure all electric power is off.
3. Loosen pan head screws, pc. #30.
4. For open or close operation set striker pc. #25 to required torque setting, matching the edge of the striker with desired number. Output torque increases with higher numbers.
5. Tighten pc. #30.
6. Operate valve electrically to seat valve, insuring tight shut-off.







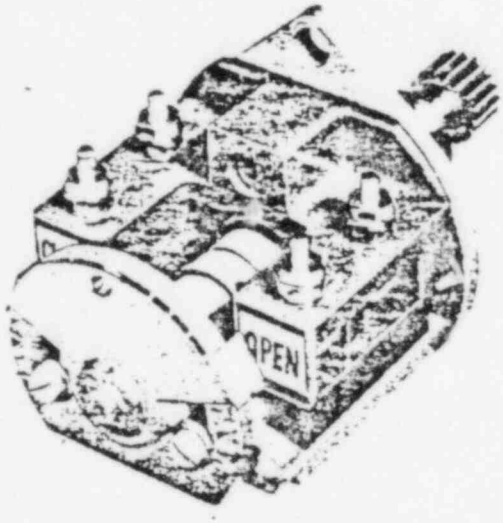
PC. NO.	NO. REQD.	DESCRIPTION
1	1	TERMINAL BLOCK
2	2	CONTACT BRIDGE
3	4	CONTACT SCREW
4	4	FINGER HOLDER
5	4	FINGER
6	4	SHUNT
7	4	SHUNT WASHER ⅛ O.D. 9/32 I.D. 1/32 THK.
8	4	RIVET
9	4	FINGER SPRING STUD
10	4	COMPRESSION SPRING
11	8	SPRING CUP WASHER
12	4	COTTER PIN (3/64 x ¼)
13	4	HEX. HD. MACH. SCR. #10-32 x ⅜
14	4	RING TORQUE CONNECTOR 18" #16 AWG TYPE TU PIGTAIL
15	4	LOCKWASHER SHAKEPROOF
16	1	TORQUE SW. MTG. BRACKET
17	1	"O" RING
18	1	"O" RING
19	2	SOC. HD. CAP SCR ¼-20 x ½ LG
20	1	CAM
21	1	TORSION SPRING
22	1	SPRING MANDREL
23	1	DIAL
24	1	SHAFT
25	2	STRIKER
26	1	TORQUE LIMITING PLATE
27	1	STRIKER HUB
28	1	ROLL PIN 1/16 Ø x ½
29	1	#4 SWAGE NUT
30	2	PAN HD. SCREW #8-32 x 5/16 LG. SLOTTED
31	2	LOCKWASHER SHAKEPROOF
32	2	FLATWASHER 9/64 I.D. x 5/16 O.D. x .032 THK.
33	1	ARM
34	1	ROLLER
35	1	ROLLER PIN
36	1	GROOVE PIN 3/32 DIA. x ½
37	1	ARC BARRIER
38	1	PAN HD. SCR. #4-40 x ¼
39	1	LOCKWASHER EXTERNAL TOOTH
40	4	WASHER 1/16 O.D. x .19/64 I.D. x 1/32 THK.
42	2	RD. HD. MACH. SCR. #10-18 x ⅝

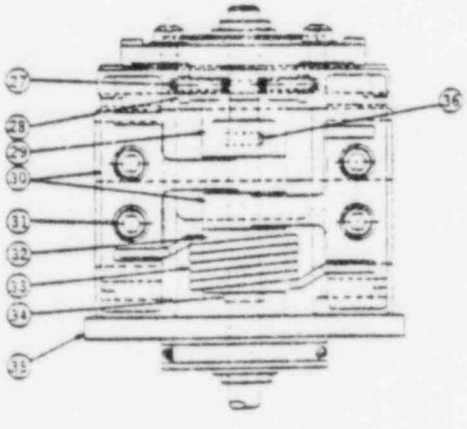
SMB-00 THRU SMB-5 DOUBLE TORQUE SWITCH

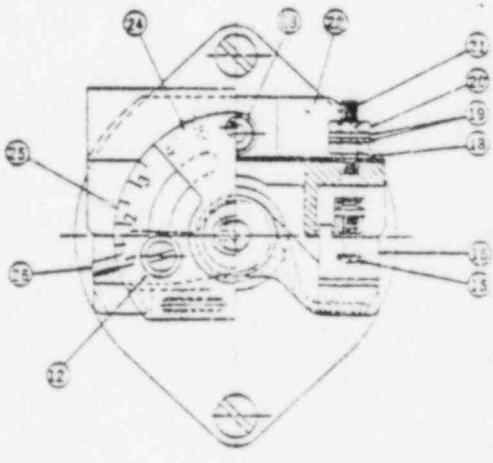
Procedure for Setting:

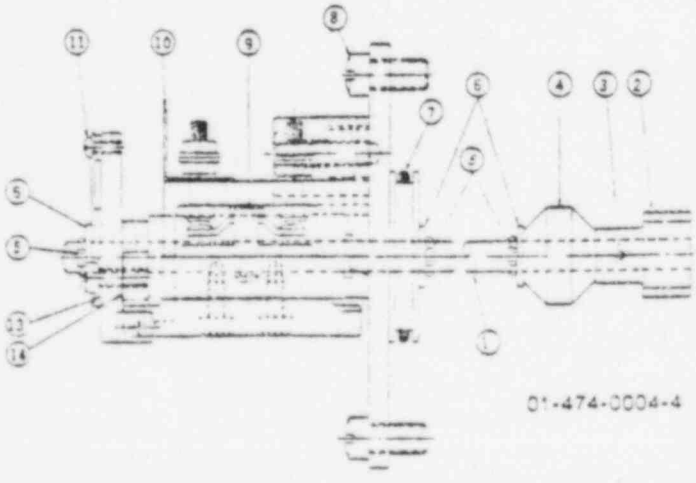
1. Torque settings must be made with switch mounted in Limitorque
2. Make sure all electric power is off
3. For the open direction torque switch or close direction torque switch loosen screw pc. #12, and set pointer, pc. #26, at desired torque setting. The higher the number, the higher the torque output of the unit.
4. Tighten pc. #12
5. Operate valve electrically to seat valve insuring tight shut-off.
6. A maximum stop setting plate is furnished on all units. Do not exceed this setting without consulting factory

PC NO	NO REQD	DESCRIPTION
1	1	SHAFT
2	1	PINION
3	1	3/32 DIA. x 1/4 LG. ROLL PIN
4	1	BUSHING
5	3	3/32 DIA. x 3/4 LG. COTTER PIN
6	3	1/16 FLAT WASHER
7	1	"O"-RING #6227-27
8	3	#9/16-18 N.C. x 3/8 LG. FILL. HD. CAP SCR.
9	2	FINGER CONTACT ASSEMBLY
10	1	INSULATOR
11	1	#5-40 N.C. x 1/4 LG. RD. HD. MACH. SCR.
12	2	#10-32 N.F. x 1/2 LG. FILL. HD. CAP SCR.
13	2	13/32 O.D. x 13/64 x .032 THK. FLAT WASHER
14	2	SHAKEPROOF EXTERNAL-INTERNAL TYPE LOCKWASHER
15	2	SCREW & LOCKWASHER
16	2	CONTACT BLOCK
18	4	#10 LOCKWASHER
19	8	#10 FLAT WASHER
20	8	#10-32 N.F. HEX NUT
21	4	TERMINAL STUD
22	1	TERMINAL BLOCK
23	1	#1/4-20 N.C. x 3/4 LG. SOC. HD. C.S. & L.W.
24	1	TORQUE LIMITER PLATE
25	1	DIAL
26	2	POINTER
27	2	#6-32 N.C. x 3/8 LG. SET SCR. CUP POINT
28	2	#6-32 N.C. HEX. NUT
29	1	ACTUATING LINK
30	2	ARMS
31	4	#10-32 N.F. x 3/4 LG. SOC. HD. CAP SCR.
32	1	SPACER
33	1	SPRING
34	1	"O" RING #6227-6
35	1	BRACKET
36	1	3/32 DIA. x 3/4 LG. ROLL PIN









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LUBRICATION
INSPECTION PROCEDURE & DATA

General:

Proper lubrication is an absolute essential in achieving the design life of all types of power transmission products and Limitorque valve controls are no exception.

The design of the actuator has been specially tailored to absolutely minimize the maintenance and re-lubrication requirements however periodic inspection is the only way to guarantee trouble-free service.

Limitorque utilizes a totally sealed gear case factory-packed with grease. The gear case can be mounted in any position (as all penetrations into it are sealed); however those mounting positions which would cause vulnerable areas of the operator (e.g. motor and limit switch compartment) to be saturated with lubricant should a seal failure occur should be avoided if possible and are not recommended. Grease is used in normal service instead of oil to minimize the impact of a seal failure (should one occur).

No seal can remain absolutely tight at all times, therefore it is not unusual to find a very small amount of weeping around shaft seals—especially during long periods of idleness such as storage. The use of grease minimizes this condition as much as possible. Should a small amount of weeping be found in the limit switch compartment on start-up, it should be removed with a clean rag. Once the equipment has begun operating, this phenomenon should disappear.

Lubrication Inspection:

It is recommended that all Limitorque operators be inspected for proper lubrication prior to operating—especially if they had been stored for a long period of time.

The frequency of lubrication inspections should be based upon historical data on the installed equipment. Every operator application has its own effect on lubricants and each facility should pattern its inspections around its particular needs. The following schedule of lubrication inspection should be followed until operating experience indicates otherwise.

Main Gear Case: Inspect lubrication on approximate intervals of 18 months or 500 cycles—whichever occurs first. Lubricate the Zerk fitting in the housing cover at the same interval.

Geared Limit Switch: Inspect lubrication on approximate intervals of 36 months or 1000 cycles—whichever occurs first.

The three primary considerations in a lubrication inspection are: (1) Quantity (2) Quality (3) Consistency.

Quantity—Limitorque operators are built to operate on the partial immersion principle. The primary concern in the amount of lubricant is whether the "worm" is totally immersed in grease. This can be verified by the use of one or more of the many "fill" and "drain" plugs provided on the operator housing.

Quality—When removing a "fill" or "drain" plug to inspect the lube level remove a small amount and insure that it is clean and free of any contaminant including water. Should dirt, water or other foreign matter be found, the units should be flushed with a commercial degreaser/cleaner like Exxon VARSOL #1 or #3 which is non-corrosive and does not affect seal materials such as Buna N or Viton. Repack unit with fresh lubricant.

Consistency—The main gear box lubricant should be slightly fluid approximating a standard NLGI-1 grade consistency or less. Thinners such as Amoco WAYTAC #31 oil may be added provided the volume of thinner does not exceed 20% of the total lubricant.

The geared limit switch lube should be soft to the touch approximating an NLGI-2 consistency or less.

LUBRICANTS
STANDARD/SUBSTITUTES/REQUIREMENTS

Standard Lubricants:

Main Unit: Exxon EP-0 for unit sizes thru SMB-4. See chart below.

Geared Limit Switch: Exxon—Beacon 325—Light Gray—acceptable substitute Mobil 28

Motor Bearings: Motors furnished with Limitorque valve controls are lubricated for life.

Lubricant Substitutes:

Typical commercially available lubricants other than those used by Limitorque for which manufacturers data indicates compatability with Limitorque operators are shown below with the temperature range recommended by the manufacturer.

The standard lubricants used by Limitorque have been proven extremely reliable over many years of service. There are, however, many other lubricants available which may be used in place of the standard.

Do not add a different lubricant to a Limitorque operator unless it is of the same soap base as the existing lubricant unless you have received the approval of the lubricant manufacturer.

The minimum lubricant qualities required by Limitorque are:

1. Should contain an "EP" additive.
2. Must be suitable for the temperature range intended.
3. Must be water and heat resistant and non-separating.
4. Must not create more than 8% swell in Buna N or Viton.
5. Must not contain any grit, abrasive, or fillers.
6. Must slump—prefer NLGI grade 0 to 1.
7. Must not be corrosive to steel gears, ball or roller bearings.
8. Dropping point must be above 316°F for temperature ranges of −20°F to 150°F.

UNIT SIZE	APPROX. VOLUME GALLONS	APPROX. WEIGHT POUNDS
SMB/SB/SBD-000	.50	3.5
SMB/SB/SBD-00	.50	4.0
SMB/SB/SBD-0	1.00	9.5
SMB/SB/SBD-1	1.50	15.0
SMB/SB/SBD-2	1.75	14.5
SMB/SB/SBD-3	5.50	50.0
SMB/SB/SBD-4	8.50	75.0
SMB-4T	8.00	71.0
SMB-5T	7.50	65.0
SMB-5	8.50	72.0

STANDARD LUBRICANTS −20°F TO 150°F

UNIT SIZE	TYPE	MANUFACTURER	COLOR	BASE
**SMB/SB/SBD 000.00	NEBULA EPO	EXXON	DARK TAN	CALCIUM COMPLEX
**SMB/SB/SBD/WB 0 TO 4	NEBULA EPO	EXXON	DARK TAN	CALCIUM COMPLEX
SMB—5	50 EP (XC-421-39)	SUN OIL CO.	BLACK	LITHIUM LEAD

**FOR NUCLEAR CONTAINMENT UNITS, NEBULA EPO IS USED ON THE SMB-000 TO 5.

LUBRICANT SUBSTITUTES

MANUFACTURER	TYPE	TEMPERATURE RANGE	BASE
EXXON	**HUMBLE P290	−40°F TO 120°F	LITHIUM LINE
ARCO	LITHOLINE HEP1	−10°F TO 220°F	LITHIUM
GULF OIL	GULFCROWN EPO	−20°F TO 220°F	LITHIUM
CITIES SERVICE	CITY AP	−0°F TO 220°F	LITHIUM
MOBIL OIL CO.	MOBILUX EPO	−10°F TO 220°F	LITHIUM 12
SHELL OIL	DARINA 0	−10°F TO 260°F	HYDROXYSTEARATE NO SOAP
FISKE	LUBRIPLATE LOW TEMP	−40°F TO 150°F	LITHIUM
TEXACO	MARFAK 0	−20°F TO 200°F	SODIUM
	LOW TEMP. EP	−40°F TO 200°F	LITHIUM
TIDEWATER OIL	VEEDOL ALITHO 10	−10°F TO 150°F	LITHIUM

**TESTED AND USED BY LIMITORQUE FOR APPLICATIONS AT LOW TEMPERATURES (−40°F TO −70°F). CONSULT LIMITORQUE IF THE TEMPERATURE RANGE IS BEYOND THE LIMITATIONS SHOWN ABOVE.

MAINTENANCE PROCEDURE

Routine Maintenance:

A schedule should be made to periodically inspect all Limitorque equipment. The time interval of this inspection should depend upon the frequency of operation and the ambient environmental conditions in which the equipment is stored or installed. A minimum inspection period of eighteen months should be used as a base until experience indicates otherwise. This routine maintenance should include —

1. Remove limit switch compartment and/or control cabiner cover. Should moisture be evident, dry the compartment and components.

2. Inspect and clean all electrical controls and contacts in the limit switch compartment and/or control cabiner. This cleaning should consist of wiping clean of all electrical contacts with electrical type solvent cleaner similar to CRC Lectra Clean and removal of foreign residue.

3. Check all terminal connections for tightness.

4. Clean gasketed surfaces on limit switch compartment and/or control cabiner cover. Replace all damaged gaskets or seals for weatherproof or submersible units. Wipe a coating (approximately 2 mils) of lightweight bearing grease on surfaces of explosion-proof cover flanges for protection.

5. Inspect lubricant per Lubrication Procedure. Visually check shaft penetrations for indications of seal leakage. If abnormal leakage is found, the seal should be replaced. (Slight oil weepage is not cause for seal replacement.) SEE MAJOR MAINTENANCE.

6. Megger the motor. (One MEG-OHM or better is considered normal.)

7. Clean and lubricate the valve stem (obtain valve manufacturer's recommendation for lubricant) for rising stem applications.

Major Maintenance:

The need for major maintenance on Limitorque equipment occurs when some operational deficiency is evident. Care should be taken to evaluate the deficiency in order to determine the extent to which the major maintenance should proceed. Major maintenance should always include the routine maintenance requirements but in addition should proceed as follows.

1. Disassembly of deficient portion of equipment.

2. Replacement of any damaged or excessively worn component with new factory parts. It is recommended that worm and worm gears be replaced as a set to ensure the greatest benefit from the replacement.

3. Replacement of lubricant if main gearbox was involved in the major maintenance.

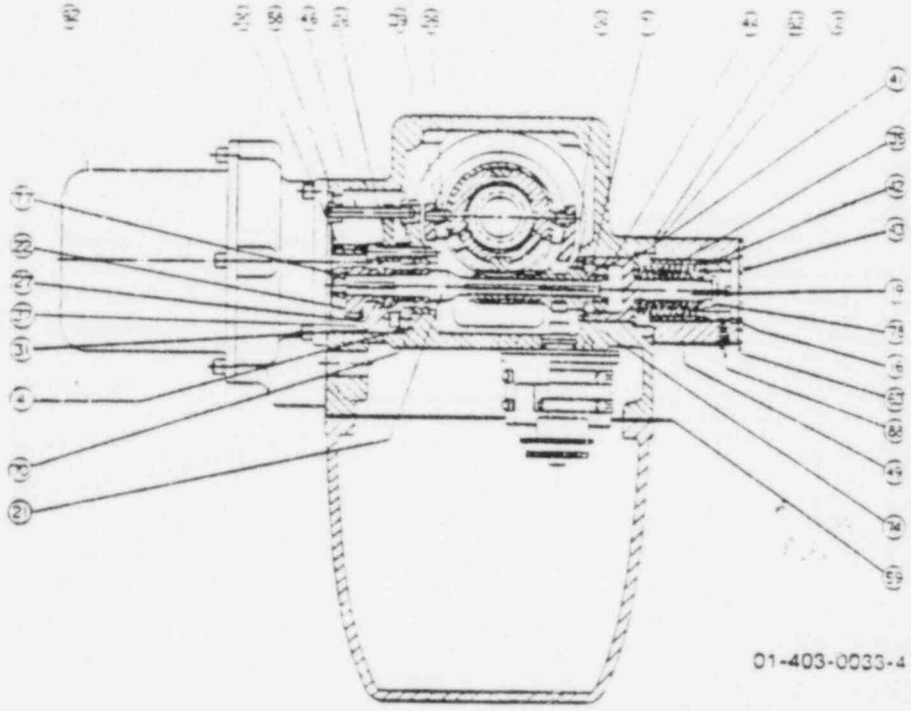
4. Replacement of all torn gaskets and seals.

5. Inspect stem and stem nut thread carefully for wear and/or damage.

6. Check operability of all electrical control components before reinstallation.

SMB-000

REF NO	DESCRIPTION
1	HOUSING
2	SPRING CARTRIDGE CAP
3	LIMIT SW COMPT COVER
4	WORM SHAFT BEARING CAP
5	HANDWHEEL
6	HOUSING CAP
7	DECLUTCH LEVER
8	DRIVE SLEEVE
9	DECLUTCH FORK
10	WORM GEAR
11	STEM NUT
14	SPACER
15	TRIPPER LEVER
16	DECLUTCH SHAFT SPACER LOCKNUT
17	DRIVE SLEEVE BEVEL GEAR
19	BEARING CARTRIDGE
20	MOTOR PINION
21	WORM SHAFT
22	WORM SHAFT GEAR
23	CLUTCH KEY
24	WORM
25	CLUTCH ROLLER PIN
26	TRIPPER ADJUSTMENT ARM
27	TRIPPER CAM
28	TRIPPER #1
29	TRIPPER #2
30	LOCKNUT
31	CAM SPACER
32	SEAL CAP
33	CLUTCH RING
34	SPACER
35	SLEEVE-TORQUE LIMIT
37	CAM SPACER
39	CLUTCH ROLLER
40	DECLUTCH SHAFT
41	THRUST WASHER
42	THRUST WASHER
43	SPRING CART CAP COVER
44	WORM BEARING NUT
45	TERMINAL MTG. BRACKET
46	ADJUSTABLE ARM PIVOT PIN
49	BELLEVILLE SPRING
50	SPRING – CLUTCH COMP
51	SPRING TRIPPER
53	BEARING SHIM
55	SHIM G. L. SW. CART ASSY
56	GASKET (MOTOR
57	GASKET (L.S. COMPT)
61	GASKET (HSG. CAP
62	GASKET (SPRING CARTRIDGE)
63	GASKET CART CAP COVER
66	ROLLER BEARING CUP
67	ROLLER BEARING CONE
68	ROLLER BEARING CUP
69	ROLLER BEARING CONE
70	BALL BEARING
71	BALL BEARING
73	RETAINING RING
74	RETAINING RING
75	RETAINING RING
76	GREASE FITTING
77	LOCKNUT
78	ELASTIC STOP NUT
79	SPRING PIN
81	BUSHING
82	BUSHING
85	QUAD RING
86	QUAD RING
87	QUAD RING
88	PIPE PLUG
89	O RING
91	MOTOR TERMINAL BLOCK
92	MOTOR ASSY
93	TORQUE SWITCH ASSY
94	L. L. SW. CART ASSY
95	G. L. SW. GEAR BOX SUB-ASSY
96	G. L. SW. PANEL SUB-ASSY



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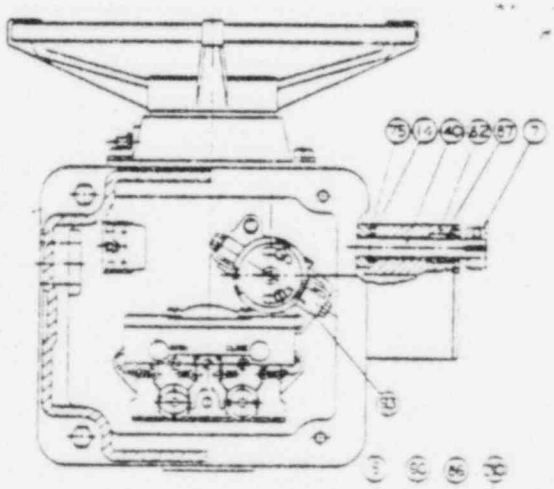
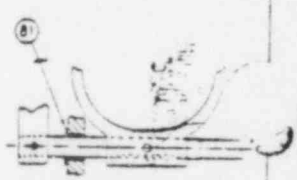
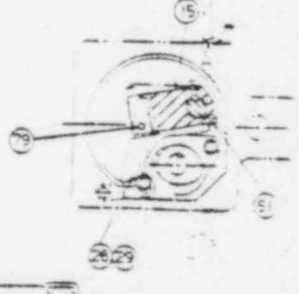
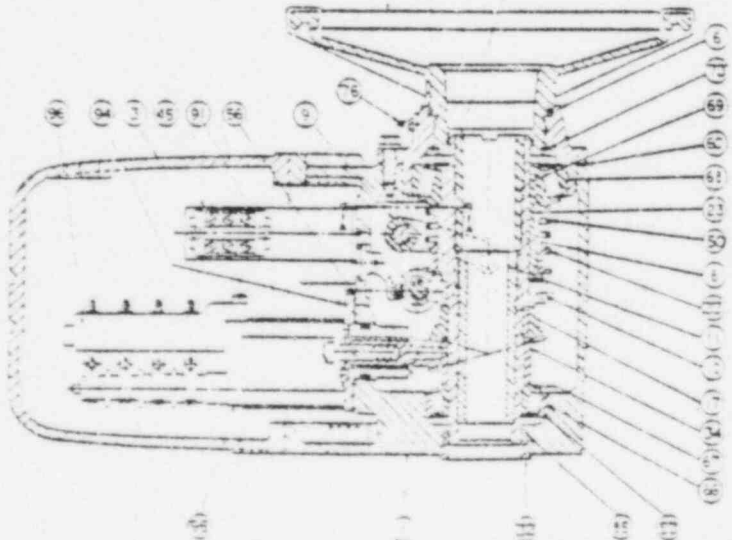




CLUTCH FORK ASS'Y
A-A





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SMB-000
DISASSEMBLY/REASSEMBLY

General:

Drawing References: 01-400-0000-4
01-400-0004-4
Exploded View: 08-400-0001-4

To disassemble the Limitorque Valve Control size SMB000, please observe the following procedure. Refer to the parts drawing of this unit whenever disassembly is to be made. Be certain to read the gasketing instructions before replacing gaskets, and be certain to keep all parts clean and free from dirt when disassembly is made.

Disassembly:

1. Shut off all power to Limitorque unit.

2. Remove the limit switch compartment cover.

3. Disconnect the leads on the geared limit switch and torque switch, making sure they are properly marked for reconnecting to the terminals. The torque switch and geared limit switch are held on the housing by two (2) screws each. Removing these screws will allow you to remove the geared limit switch and the torque switch.

4. To remove the electric motor from the Limitorque operator, first disconnect the motor leads inside of the limit switch compartment. The motor leads must be guided through the conduit opening while removing the motor.

5. The motor pinion, pc #20, is keyed to the motor shaft and held there with a set screw to retain the pinion in its proper position.

6. Put unit in manual operation by depressing declutch lever, pc #7.

7. Remove declutch lever, pc #7.

8. Remove spring cartridge cap cover, pc #43.

9. Remove spring cartridge cap, pc #2.

10. Remove worm, pc #24, and torque spring assembly by pulling directly out.

11. Remove clutch tripper lever assembly, pc #15. Note a hex head cap screw locates and secures the tripper lever on the declutch shaft (end of shaft should be flush with tripper lever).

12. Remove housing cap, pc #6, and handwheel assembly.

13. Remove drive sleeve assembly completely including pcs #8, 10, 11, 17, 30, 33, 34, 50, 67, and 69. To disassemble, see Step #21.

14. Remove worm shaft gear, pc #22, by removing locknut, pc #77.

15. Remove tripper cam, pc #27, and cam spacers, pcs #31 and 37.

16. Remove worm shaft, pc #21, and worm shaft bearing cap, pc #4.

17. To remove worm, pc #24, from worm assembly, remove internal retaining ring, pc #74.

18. To remove torque spring, pc #49, first remove elastic stop nut, pc #78, noting the number of turns to remove.

19. Remove thrust washer, pc #42, limiter sleeve, pc #35, torque spring (discs), pc #49, thrust washer, pc #41, noting the orientation of the torque spring discs, spacers and thrust washers.

20. To remove declutch lever shaft, pc #40, or clutch fork, pc #9, pull the declutch lever shaft out of the actuator from the motor side of the unit. It will be necessary to remove the retaining ring, pc #70, on the opposite side of the actuator before removing the declutch shaft.

21. To disassemble the drive sleeve assembly, press off the lower drive sleeve bearing, pc #66. All remaining components should now slide off the drive sleeve easily.

Reassembly:

To reassemble, follow the above procedure in the reverse order noting the following:

21. When reinstalling declutch fork, pc #9, be sure to orient it on the declutch shaft as shown on the exploded view.

19. Be sure thrust washers, torque spring (discs) and spacers are reinstalled exactly as removed.

18. Replace elastic stop nut, pc #78, with exact number of turns used to remove.

7. Manually declutch unit and rotate worm shaft gear, pc #22.

To Adjust Clutch Trippers:

1. Follow Steps 1, 2, and 4.

2. Loosen lock screw on tripper adjustment arm, pc #26.

3. Hold down declutch lever, pc #7.

4. Lifting adjusting arm up to touch tripers, pcs #28 and 29, and tighten lock screw (previously loosened in Step 2), while holding down declutch lever.

5. Rotate worm shaft gear to ensure unit shifts into motor operation automatically.

6. Declutch unit again and repeat Step 5.

To Replace the Stem Nut Only: If the stem nut, pc #11, is to be removed from the assembled Limitorque valve control, it is necessary to remove the locking nut, pc #30, and then remove stem nut by lifting out top of unit.

CAUTION! Do not remove with unit under load or with valve under pressure (See below).

The locknut, pc #30, is staked in two places so it will be necessary to locate the stakes and spot with a drill. Clean all metal particles and remove. If Limitorque is mounted on a valve having a threaded stem, and removal of the stem nut is required, merely remove the locking nut, pc #30, as mentioned above, then rotate the handwheel of the Limitorque operator to close the valve. The stem nut will rise up the threaded stem of the valve. When the stem nut splines are free from the drive sleeve, the stem nut may be rotated by hand and remainder of the length of the valve stem and replaced, if necessary. When new stem nut is installed with pc #30, stake the top threads in two places. If valve must be left in service while the stem nut is replaced, the valve stem must be locked in such a way as to prevent any movement of valve stem.

Gasketing Instructions: All gaskets except the housing cover gaskets are 1/32" thick anchorite. The housing cover gaskets vary in thickness and to determine correct size follow the following procedure:

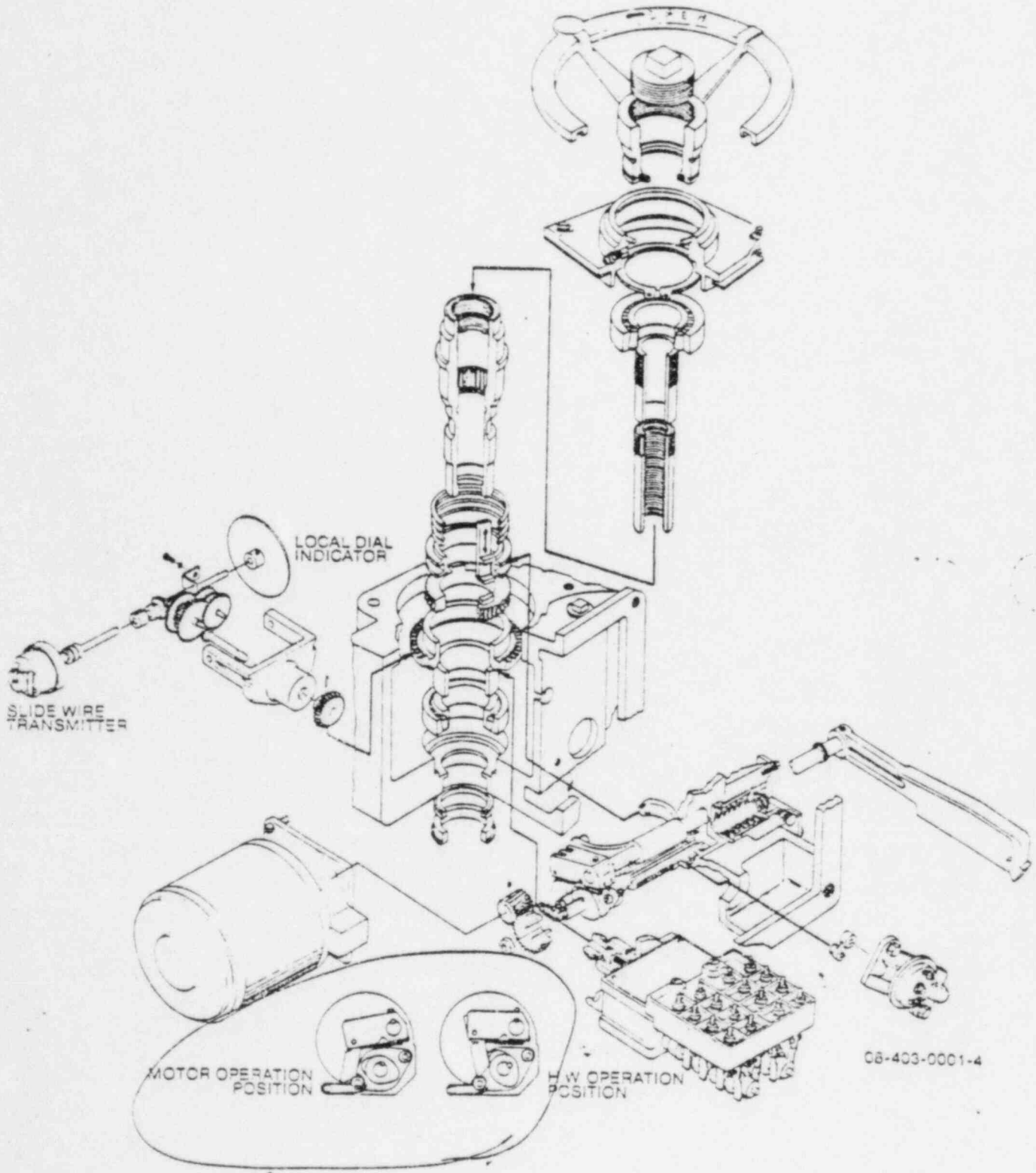
1. Clean both housing cover and main housing gaskered surface.

2. Install unit drive sleeve assembly complete with bearings.

3. Install housing cover and measure the gap between the housing cover and the main housing.

4. Take measurement found in Step 3 and add 10% to it and use the closest nominal gasket thickness or combination available.

SMB-000



Ref. CIWA 815999

SMB-00
DISASSEMBLY/REASSEMBLY

General:

Drawing References: 01-400-0005-4
01-400-0006-4
Exploded View: 08-400-0002-4

To disassemble the Limitorque Valve Control size SMB-00, please observe the following procedure. Refer to the parts drawing of this unit whenever disassembly is to be made. Be certain to keep all parts clean and free from dirt during disassembly.

Disassembly:

1. Shut off all power to Limitorque unit.

2. Remove or swing open the limit switch compartment cover.

3. Disconnect the leads on the geared limit switch and torque switch making sure they are properly marked for reconnecting to the terminals. The torque switch and geared limit switch are held on the housing by two (2) screws each. Removing these screws will allow you to remove the geared limit switch and the torque switch.

4. To remove the electric motor from the Limitorque operator, first disconnect the motor leads inside of the limit switch compartment. The motor leads must be guided through the conduit opening while removing the motor.

5. The motor pinion, pc #20, is keyed to the motor shaft and held there with a set screw to retain the pinion in its proper position.

6. Put unit in manual operation by depressing declutch lever, pc #5.

7. Remove declutch lever, pc #5.

8. Remove spring cartridge cap cover, pc #25.

9. Remove spring cartridge cap, pc #3.

10. Remove worm, pc #19, and torque spring assembly by pulling directly out.

11. Remove clutch tripper lever assembly, pc #10. Note a hex head cap screw locates and secures the tripper lever on the declutch shaft (end of shaft should be flush with tripper lever).

12. Remove housing cap, pc #88, and handwheel assembly for top mounted handwheel. **WARNING! Do not remove if a thrust load is on the actuator or if the valve is under pressure and not fully open as personal injury may result.**

13. For side mounted handwheel, remove bevel gear housing, pc #96, and entire handwheel assembly (including pc #98, bevel gear cartridge).

14. Remove drive sleeve assembly completely including pcs #4, 7, 8, 12, 14, 28, 29, 30, 40, 64, and 66. To disassemble see Step 22.

15. Remove worm shaft gear, pc #18, by removing locknut, pc #73.

16. Remove tripper cam, pc #24, and cam spacers, pcs #31 and 36.

17. Remove worm shaft, pc #17, and worm shaft bearing cap, pc #35.

18. To remove worm, pc #19 from worm assembly, remove internal retaining ring, pc #71.

19. To remove torque spring, pc #46, first remove elastic stop nut, pc #74, noting the number of turns to remove.

20. Remove thrust washer, pc #39, limiter sleeve, pc #32, torque spring (disc), pc #46, thrust washer, pc #38, noting the orientation of the torque spring discs, spacers, and thrust washers.

21. To remove declutch lever shaft, pc #34, of clutch fork, pc #6, pull the declutch lever shaft out of the actuator from the motor side of the unit. It will be necessary to remove the retaining ring, pc #70, on the opposite side of the actuator before removing the declutch shaft.

22. To disassemble the drive sleeve assembly, press off the lower drive sleeve bearing, pc #66. All remaining components (except pcs #12 and 64) should now slide off the drive sleeve easily.

23. To remove G.L. drive hypoid gear, pc #12, press off the upper drive sleeve bearing, pc #64, and slide pc #12 off drive sleeve.

Reassembly:

To reassemble, follow the Disassembly Procedure in the reverse order noting the following:

Follow gasketing instruction below.

21. When reinstalling declutch fork, pc #6, be sure to orient it on the declutch shaft as shown on the exploded view.

20. Be sure thrust washers, torque spring (discs), and spacers are reinstalled exactly as removed.

19. Replace elastic stop nut, pc #74, with exact number of turns used to remove.

7. Manually declutch unit and rotate worm shaft gear, pc #18.

To Adjust Clutch Trippers:

1. Follow Steps 1, 2, and 4.

2. Loosen lock screw on tripper adjustment arm, pc #21.

3. Hold down declutch lever, pc #5.

4. Lift adjusting arm up to touch trippers pcs #26 and 27 and tighten lock screw (previously loosened in Step 2), while holding down declutch lever.

5. Rotate worm shaft gear to ensure unit shifts into motor operation automatically.

6. Declutch unit again and repeat Step 5.

To Replace the Stem Nut Only: If the stem nut, pc #5, is to be removed from the assembled Limitorque Valve Control, it is necessary to remove the locking nut, pc #30, and then remove stem nut by lifting out of unit.

WARNING! Do not remove locknut, pc #3, with unit under load or with valve under pressure. (See warning for Step 12.)

The locknut, pc #30, is staked in two places so it will be necessary to locate the stakes and spot with a drill. Clean all metal particles and remove. If Limitorque is mounted on a valve having a threaded stem and removal of the stem nut is required merely remove the locking nut, pc #30, as mentioned above, then rotate the handwheel of the Limitorque operator to close the valve. The stem nut will rise up the threaded stem of the valve. When the stem nut splines are free from the drive sleeve, the stem nut may be rotated by hand the remainder of the length of the valve stem and replaced, if necessary. When new stem nut is installed with pc #30, stake the top threads in two places.

If the valve must be left in service while the stem nut is replaced, the valve stem must be locked in such a way as to prevent any movement of valve stem.

Gasketing Instructions: All gaskets except the housing cover gaskets are 1/32" thick anchorite. The housing cover gaskets vary in thickness and to determine correct size follow the following procedure:

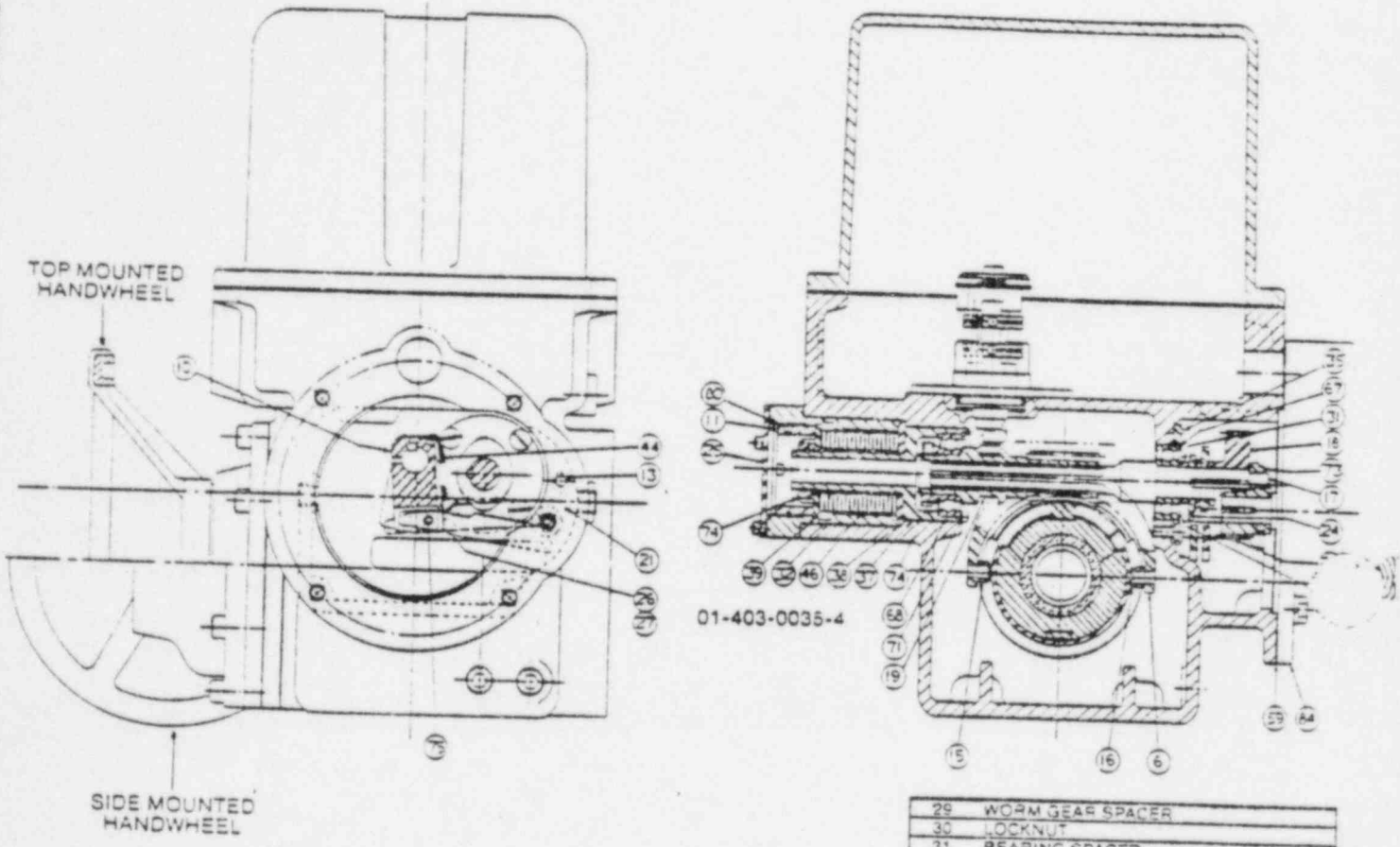
1. Clean both housing cover and main housing gaskered surface.

2. Install unit drive sleeve assembly complete with bearings.

3. Install housing cover and measure the gap between the housing cover and the main housing.

4. Take measurement found in Step 3 and add 10% to it and use the closest nominal gasket thickness or combination available.

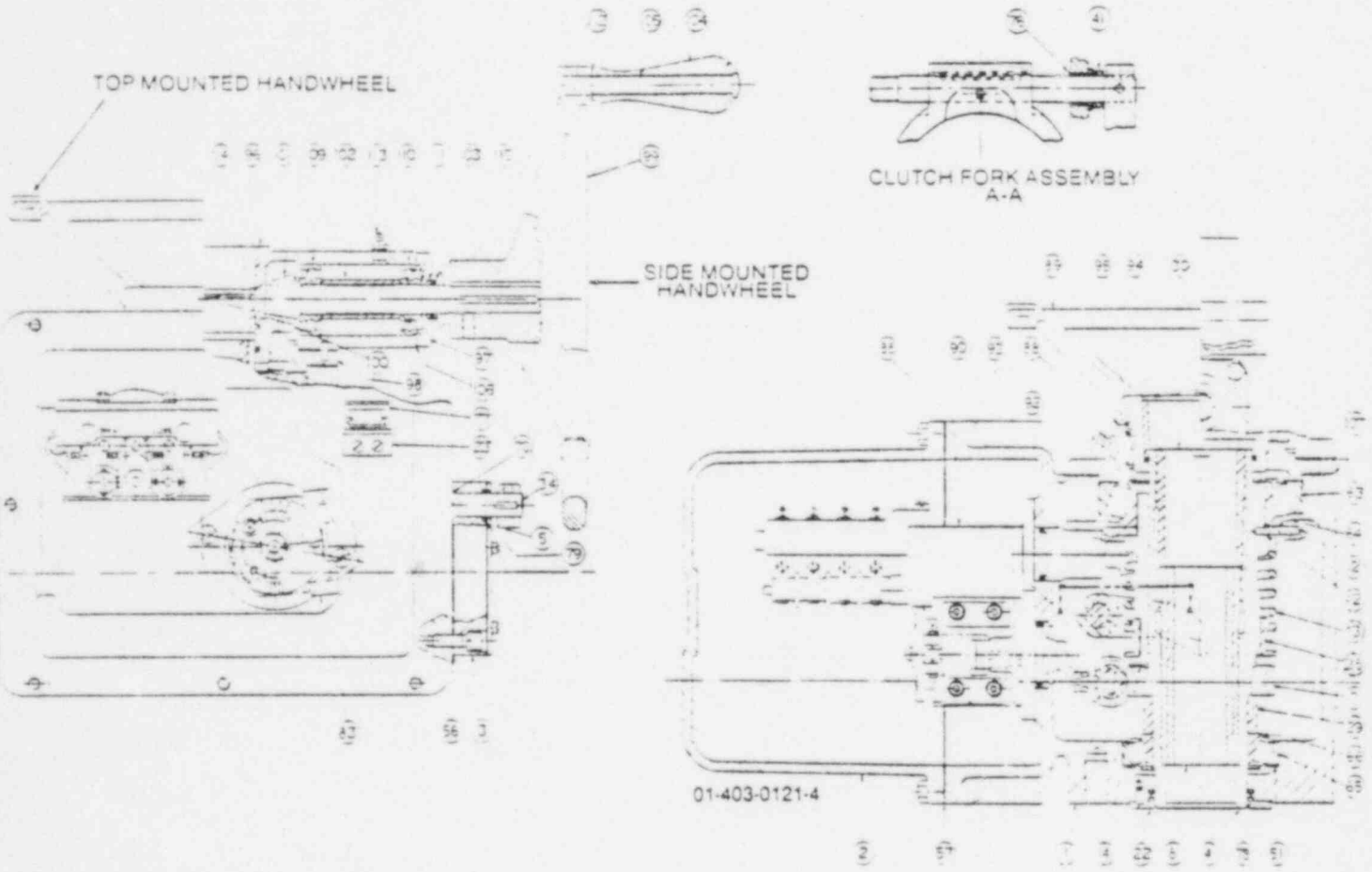
SMB-00



PC NO	DESCRIPTION
1	HOUSING
2	LIMIT SWITCH COMPART COVER
3	SPRING CARTRIDGE CAP
4	DRIVE SLEEVE
5	DECLUTCH LEVER
6	DECLUTCH FORK
7	WORM GEAR
8	STEM NUT
10	TRIPPER LEVER
11	LOCKNUT
12	G L DRIVE HYPOID GEAR
13	TRIPPER ADJUST ARM PIN
14	CLUTCH KEY
15	CLUTCH ROLLER
16	CLUTCH ROLLER PIN
17	WORM SHAFT
18	WORM SHAFT GEAR
19	WORM
20	MOTOR PINION
21	TRIPPER ADJUST ARM
22	SEAL RETAINING PLATE
23	TERMINAL BRACKET
24	TRIPPER CAM
25	SPRING CART CAP COVER
26	TRIPPER #1
27	TRIPPER #2
28	CLUTCH RING

29	WORM GEAR SPACER
30	LOCKNUT
31	BEARING SPACER
32	TORQUE LIMIT SLEEVE
34	DECLUTCH SHAFT
35	WORM SHAFT BEARING CAP
36	CAM SPACER
37	BEARING CARTRIDGE
38	THRUST WASHER
39	THRUST WASHER
41	TRIPPER LEVER SPACER
42	DOWEL
43	CLUTCH RETURN SPRING
44	TRIPPER SPRING
46	BELLEVILLE SPRINGS
51	BEARING SHIMS
56	GASKET
57	GASKET
58	GASKET
63	ROLLER BEARING CUP
64	ROLLER BEARING CONE
65	ROLLER BEARING CUP
66	ROLLER BEARING CONE
67	BALL BEARING
68	BALL BEARING
70	RETAINING RING
71	RETAINING RING
73	LOCKNUT
74	LOCKNUT
75	SPRING PIN
76	BUSHING
77	MOTOR TERMINAL BLOCK
78	QUAD RING
79	WEAR RING
80	O RING
82	TORQUE SWITCH ASSY
84	WORM ASSY
85	BEARED LIMIT SWITCH

SMB-00



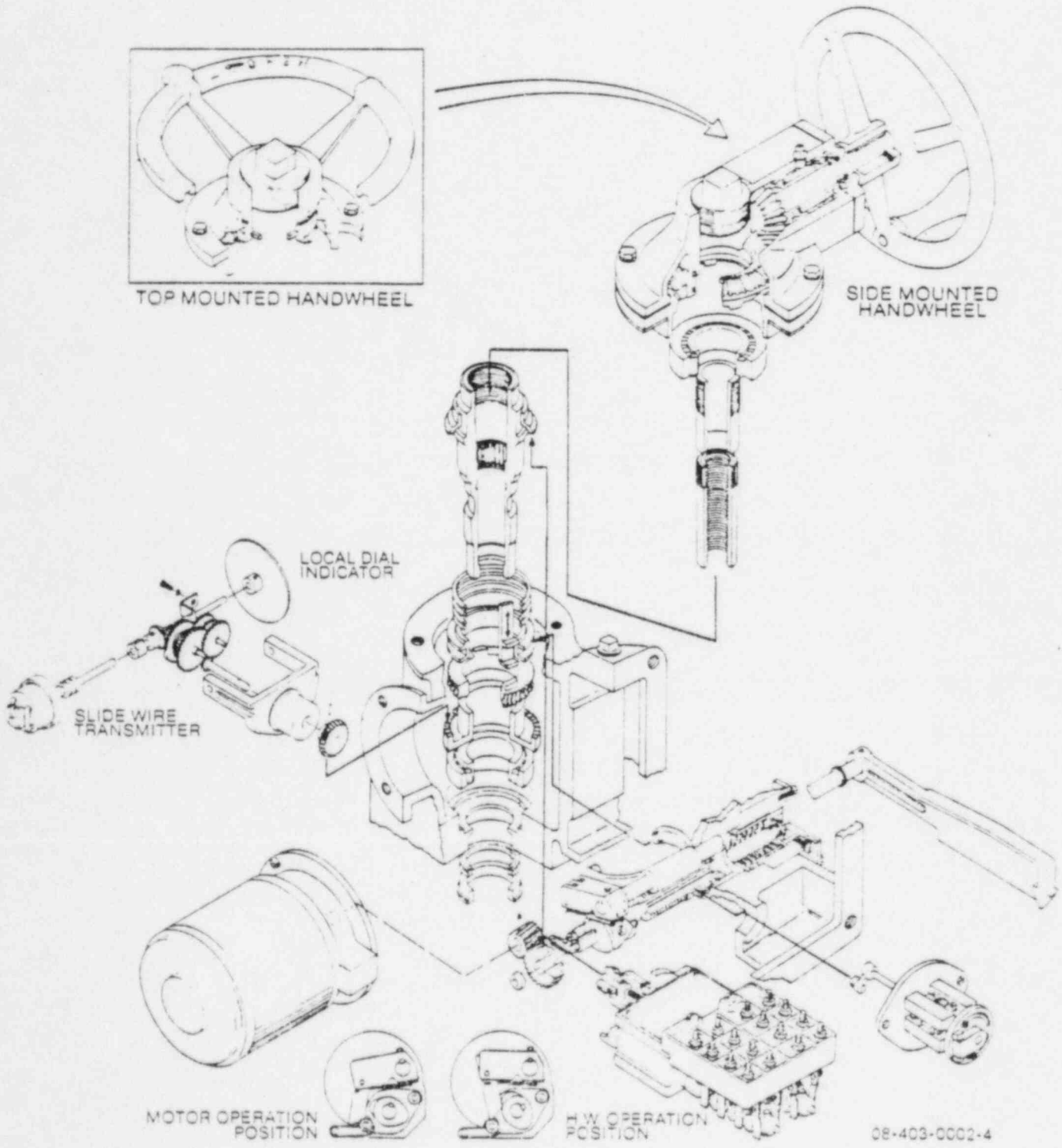
PC NO.	DESCRIPTION
86	HOUSING COVER
89	HANDWHEEL
90	HOUSING COVER GASKET
92	RETAINING RING
93	GREASE FITTING
94	QUAD RING
95	O RING

TOP MOUNTED HANDWHEEL

96	BEVEL GEAR HOUSING
97	BEVEL PINION CAP
98	BEVEL GEAR CARTRIDGE
99	HANDWHEEL
100	BEVEL GEAR
101	HANDWHEEL BEVEL PINION
102	BEARING SPACER
103	O RING SPACER
104	HANDLE
105	HANDLE ROD
106	GASKET
107	GASKET
109	BALL BEARING
110	BALL BEARING
111	RETAINING RING
112	RETAINING RING
113	GREASE FITTING
114	QUAD RING
115	O RING

SIDE MOUNTED HANDWHEEL

SMB-00


TOP MOUNTED HANDWHEEL
SIDE MOUNTED HANDWHEEL
LOCAL DIAL INDICATOR
SLIDE WIRE TRANSMITTER
MOTOR OPERATION POSITION
H.W. OPERATION POSITION
08-403-0002-4

SMB-0 TO SMB-4 & SMB-4T
DISASSEMBLY

General:

Drawing References 01-408-0010-4
01-408-0073-4
01-408-0074-4

Exploded View 08-408-0001-4

The disassembly of the Limitorque Valve Control size SMB-0 will be used as a general example. Refer to the parts drawings of these units whenever disassembly is to be made. Be certain to keep all parts clean and free from dirt when disassembly is made.

Disassembly:

To completely disassemble the Limitorque Valve Control size SMB-0 through SMB-4 and SMB-4T please observe the following procedure:

1. Shut off all power to Limitorque unit.

2. Swing open or remove the limit switch compartment cover.

3. Disconnect the leads on the geared limit switch and torque switch, making sure they are properly marked for reconnecting to the terminals before removing these parts. The torque switch and geared limit switch are held on the housing by two (2) screws each. Removing these screws will allow you to remove the geared limit switch and the torque switch.

4. To remove the electric motor from the Limitorque operator, first disconnect the motor leads inside of the limit switch compartment. The motor leads must be guided through the conduit opening while removing the motor.

5. The motor pinion, pc #40, is keyed to the motor shaft and held there with a set screw and lockwire to retain the pinion in its proper position. (The motor pinion should be shouldered on the motor shaft.)

6. Put unit in manual operation by depressing declutch lever, pc #10.

7. Remove handwheel, pc #5, by loosening set screw. Handwheel can then be pulled from handwheel shaft, pc #25.

8. Remove declutch lever, pc #10, by loosening set screw and sliding lever from declutch shaft, pc #24.

9. Remove end cap, pc #4. **CAUTION! Declutch lever shaft must be held in position and not allowed to be pulled out when removing the end cap. A loud snap will be heard on removal of this end cap which is the torsion spring, pc #54, being released. Do not be alarmed. Later models have declutch lever shaft held in place by a snap ring located behind the declutch link.**

10. Remove worm and torque spring assembly completely by temporarily replacing the handwheel and then rotating in the close direction to cause the worm to screw out of engagement and worm gear and causing torque spring cartridge to emerge from housing. The cartridge may be further disassembled if required. (See Step 22).

11. Remove housing cover, pc #3.

WARNING! Do not remove if a thrust load is on the actuator or if the valve is under pressure and not fully open as personal injury may result.

12. Lift complete drive sleeve assembly from unit housing. The drive sleeve assembly consists of locking nut, pc #30, stem nut, pc #20, drive sleeve, pc #11, upper thrust bearings, pcs #77 and 78, worm gear, pc #16, worm gear spacer, pc #28, and lower thrust bearing, pcs #75 and 76. The drive sleeve assembly may be further dismantled if required by pressing off lower drive sleeve bearing, pc #75.

13. Remove retaining ring, pc #89, split ring retainer, pc #27, and split ring, pc #47. Removal of these three pieces will allow the worm shaft clutch gear, pc #41, to be pulled from the worm shaft.

14. Remove spacer, pc #46, (only on SMB-0 and SMB-1).

15. Spread clutch trippers with a tool (do not use hands as spring forces could result in personal injury) to shift unit into motor operation.

16. Remove bolts holding clutch housing, pc #1, to housing, pc #2, and withdraw clutch housing together with trippers, pcs #32 and 33, and fork, pc #12. Worm shaft clutch, pc #50, will slide off worm shaft when withdrawing clutch housing.

17. Slide clutch spring, pc #58, off of worm shaft toward motor end. Slide declutch link, pc #9, off splined manual declutch shaft, pc #24.

18. Remove elastic stop unit, pc #84, and pull handwheel gear, pc #7, which is keyed to the shaft, pc #25.

19. Remove bolts holding shaft bearing cap, pc #8, and slide cap off worm shaft. Handwheel clutch pinion, pc #42, may be removed from bearing cap by removing retaining ring, pc #92, being careful not to lose spring, pc #57, and spring ring, pc #17.

20. Remove handwheel shaft by tapping on the motor end of the shaft which will free bearing, pc #80 from housing. Handwheel shaft will break free from bearing, pc #79, and may then be removed from housing.

21. Having removed declutch link from splined end of declutch shaft (Step 16), shaft may be withdrawn from handwheel end of housing.

22. If the worm assembly (removed in Step 11) is to be disassembled further, remove elastic stop nut, pc #85, noting the number of turns to remove.

23. Remove thrust washers, pc #48, limit sleeve, pc #29, and Belleville disc springs, pc #5a, noting the orientation of the discs for reassembly later.

24. The bearing cartridge stem, pc #45, is threaded into the bearing cartridge cap, pc #44. To remove, locate set screw in threaded area and unscrew.

25. Remove the worm, pc #53, and ball bearing, pc #82.

26. To remove the ball bearing, pc #82, locate set screw in bearing locknut and remove set screw and locknut, pc #83.

SMB-0 TO SMB-4 & SMB-4T

(1) Two required on SMB3 & 4
(2) Only on SMB1 & 2

PC. NO.	DESCRIPTION
1	CLUTCH HOUSING
2	HOUSING
3	HOUSING COVER
4	SPRING CARTRIDGE CAP
5	HANDWHEEL 12
6	LIMIT SW. COMP. COVER
7	HANDWHEEL GEAR
8	WORM SHAFT BEARING CAP
9	DECLUTCH LINK
10	DECLUTCH LEVER
11	DRIVE SLEEVE
12	DECLUTCH FORK
16	WORM GEAR
17	SPRING RING
18	BUSHING
19	BUSHING
20	STEM NUT
24	MANUAL DECLUTCH SHAFT
25	HANDWHEEL SHAFT
26	SEAL RETAINER PLATE
27	SPLIT RING RETAINER
28	WORM GEAR SPACER
29	TORQUE LIMIT SLEEVE
30	LOCKING NUT
31	MOTOR CONDUIT NIPPLE
32	CLUTCH TRIPPER #1
33	CLUTCH TRIPPER #2
34	FORK PIVOT PIN
35	HANDLE
36	HANDLE ROD
37	DRUM
38	UPPER HINGE
39	LOWER HINGE
40	MOTOR PINION
41	W.S. CLUTCH GEAR
42	H.W. CLUTCH PINION
43	WORM SHAFT
44	BEARING CARTRIDGE CAP
45	BEARING CARTRIDGE STEM
46	SPACER (2)
47	SPLIT RING
48	THRUST WASHER
49	CLUTCH ROLLER
50	W.S. CLUTCH
51	TRIPPER PIN
52	CLUTCH ROLLER PIN
53	WORM
54	TORSION SPRING
55	"O" RING SPACER
56	BELLEVILLE SPRING
57	H.W. PINION SPRING
58	FORK RETURN SPRING
59	TRIPPER SPRING
60	NAMEPLATE
66	HOUSING COVER GASKET
67	CLUTCH HSG. & MOTOR GASKET
68	SPRING CART. CAP GASKET
69	L.S. COMP. COVER GASKET
70	LOCKNUT
71	SPRING CART. CAP PLATE
72	SPRING CART. CAP PLATE GASKET
74	BEARING SHIMS
75	ROLLER BEARING CONE
76	ROLLER BEARING CUP
77	ROLLER BEARING CONE
78	ROLLER BEARING CUP
79	BALL BEARING
80	BALL BEARING
81	BALL BEARING (1)
82	BALL BEARING
83	BEARING LOCKNUT
84	ELASTIC STOP NUT
85	ELASTIC STOP NUT
86	RETAINING RING
87	RETAINING RING
88	RETAINING RING
89	RETAINING RING
90	RETAINING RING
91	RETAINING RING
92	RETAINING RING
93	QUAD RING
94	QUAD RING
95	O RING
96	O RING
97	BUSHING
98	GREASE FITTING
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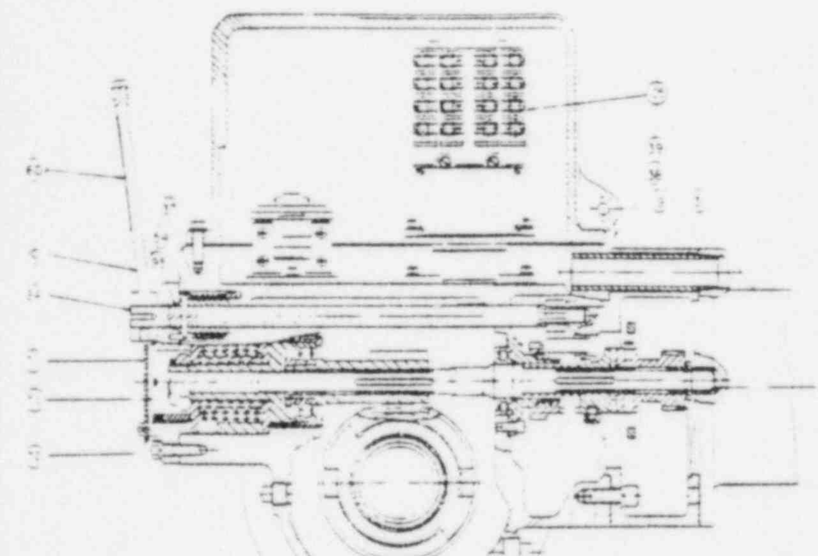
104	TORQUE SWITCH
105	GEARED LIMIT SWITCH



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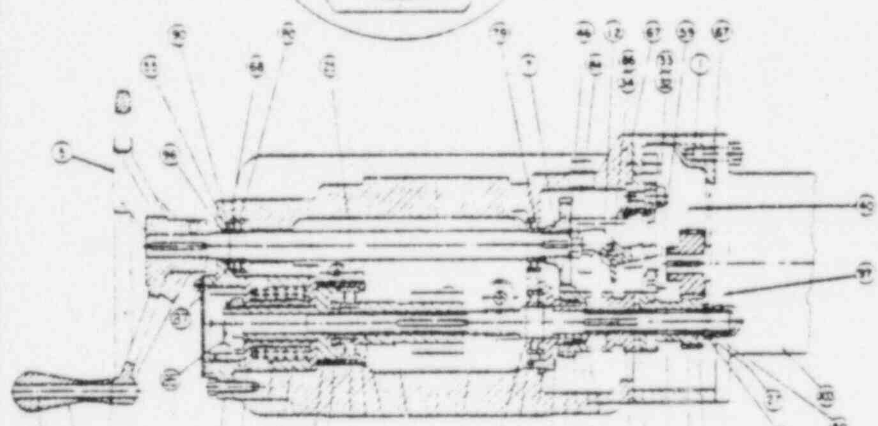

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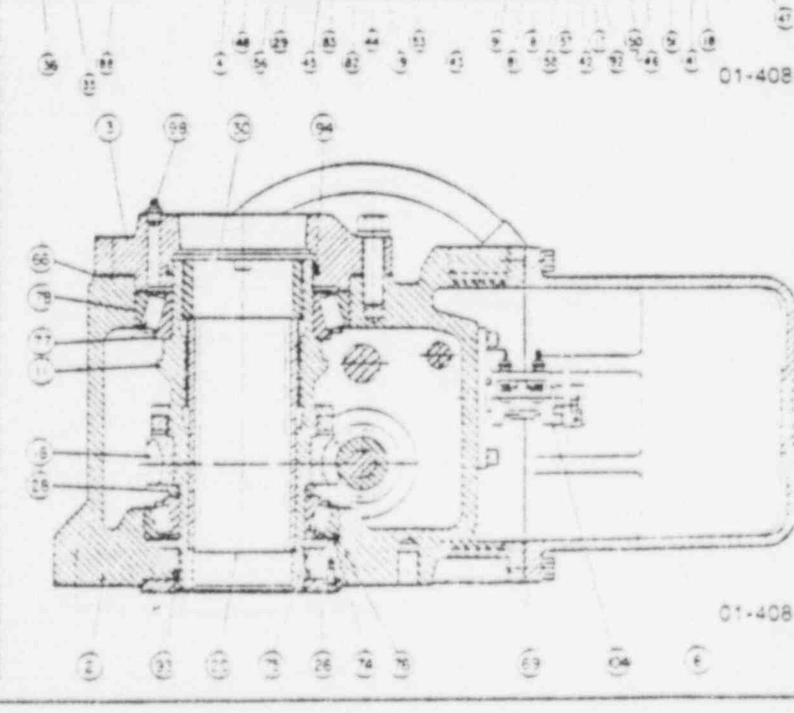


01-408-0013-4

SMB-5 & SMB-5T
DISASSEMBLY OF VALVE OPERATOR

General:

Exploded View 08-408-0002-4

Thrust Assembly 01-410-0060-4

The SMB-5 is a thrust type actuator made up of an SMB-5T torque type unit mounted on a thrust bearing assembly. If the existing unit is an SMB-5T "torque only" disregard the first section of this procedure (Steps A1 and A2).

SMB-5 (Thrust Unit Only):

A1. **CAUTION:** Ensure that unit is not under load and that valve is not under pressure before proceeding. If so, the valve must be in the full open position.

A. Remove drive sleeve locknut, pc #100.

WARNING! SMB-5 drive sleeve locknut has left hand threads and must be rotated clockwise to remove.

B. Rotate handwheel to close valve causing stem nut, pc #127, to rise up threaded valve stem until stem nut splines are free of drive sleeve, pc #126.

C. Rotate stem nut by hand for remainder of length of valve stem and remove.

A2. Remove thrust adapter assembly, pc #125, from operator.

NOTE: If disassembly of thrust adapter assembly is not required, continue to Step 1. If thrust adapter is to be disassembled, proceed as follows:

A. Remove seal retainer plate, pc #129, and oil seal, pc #132.

B. Loosen set screw and remove thrust bearing cartridge, pc #128, from thrust adapter housing, pc #125.

C. Remove upper bearing roller assembly, pc #131.

D. Lift thrust drive sleeve, pc #126, out of thrust adapter housing, pc #125.

E. Remove lower bearing roller assembly, pc #131.

SMB-5T (Torque Unit):

1. To disassemble, please observe the following procedure:

A. Remove limit switch compartment cover, pc #12.

B. Disconnect motor leads and leads to torque switch, pc #116, and geared limit switch, pc #117.

Note: Ensure leads are labeled for reassembly.

C. Remove torque switch and geared limit switch.

2. Using lifting eyebolts, remove housing cover, pc #3, drive sleeve, pc #11, and worm gear, pc #17.

3. Remove handwheel washer, pc #60, and pull off handwheel, pc #10, and handwheel clutch, pc #13, from handwheel shaft, pc #40.

4. Remove worm shaft end cap, pc #7, and declutch housing cover, pc #4.

5. Remove declutch assembly as follows:

A. Remove declutch stop, pc #28, tripper spring, pc #67, trippers, pc #34, and roll pin, pc #110.

B. Loosen set screws on declutch lever, pc #9, and collar, pc #103, remove declutch lever, declutch shaft end cap, pc #59, and slide declutch shaft, pc #30, out through bottom of unit.

C. Remove declutch fork, pc #14, and other declutch shaft mounted components, pc #66, pc #70, pc #69, and pc #103, from unit.

D. Remove handwheel shaft and pinion, pc #40.

6. Remove drive shaft, pc #43, and flexible jaw clutch, pc #50, as integral assembly, gear clutch spacer, pc #47, sliding clutch gear, pc #51, and clutch compression spring, pc #68.

7. Remove splined insert, pc #54, using jack screws, Spirolox ring, pc #107, and handwheel gear, pc #6.

8. A. Remove gear mounting bracket, pc #8, using jackscrews, bearing, pc #93, and bearing adapter, pc #65.

B. Pull hollow drive shaft, pc #55, toward declutch end and remove Spirolox ring, pc #106.

9. Remove declutch housing, pc #2.

10. A. Push hollow drive shaft, pc #55, toward motor end, loosen set screw and remove bearing locknut, pc #99. (Hold hollow drive shaft using adjustable spanner on splines.)

B. Remove bearing, pc #95, by pushing hollow drive shaft toward declutch end.

C. Remove gear limit threaded collar, pc #32, and key.

D. Remove hollow drive shaft, pc #55, from declutch end of unit.

11. A. Loosen set screw in cartridge stem locking nut, pc #48, and replace declutch housing, pc #2, with two screws to compress torque spring.

B. Remove locking nut, pc #48.

12. **CAUTION!** Declutch Housing is under spring load.

A. Remove declutch housing, pc #2.

B. Pull bearing cartridge stem, pc #45, out partially and remove thrust washers, pc #46, torque limit sleeve, pc #62, and springs, pc #58.

13. Remove bearing cartridge/worm assembly from unit. To disassemble further:

A. Loosen two set screws on bearing cartridge cap, pc #44, and unscrew bearing cartridge stem, pc #45.

B. Slide bearing cartridge cap off toward worm threads.

C. Loosen set screw and remove bearing locknut, pc #100.

D. Press off two bearings, pc #90, and pc #91.

14. Remove motor, pc #115, motor adapter, pc #5, intermediate pinion shaft gear assembly, pc #15, pc #41 as an integral assembly, drive shaft gear, pc #42, and bearing spacer, pc #64.

SMB-5 & SMB-5T
REASSEMBLY OF VALVE OPERATOR

SMB-5T (Torque Unit):

To reassemble observe the following procedure:

1. A. Press two bearings, pcs #90 and 91, onto worm, pc #56 ensuring that bearing races are matched. (It may be necessary to apply heat to bearings.) Ensure that bearing spacer, pc #92, is installed.

   B. Install bearing locknut, pc #100 and tighten set screw.

   C. Apply heat to bearing cartridge cap, pc #44, and drop on bearing from worm end. Ensure that cartridge cap seats on bearing.

   D. Thread bearing cartridge stem, pc #45, tightly into cartridge cap and tighten two set screws.

   E. Install bearing cartridge/worm assembly in housing.

2. A. Replace in following order: thrust washer, pc #46, Belleville springs, pc #58, torque limit sleeve, pc #62, and thrust washer, pc #46. Ensure flat side of thrust washer is against springs.

   B. Thread cartridge stem nut, pc #48, onto bearing cartridge stem, pc #45, by hand.

   C. Slide bearing cartridge/worm assembly into housing.

3. A. Install hollow drive shaft, pc #55.

   B. Install gear limit threaded collar, pc #32, and key on motor end of hollow drive shaft with threaded end toward worm.

   C. Slide bearing, pc #95, onto shaft.

   D. Thread bearing locknut, pc #99, on shaft and tighten set screw. (Hold drive shaft using adjustable spanner on splines.)

4. A. Push hollow drive shaft, pc #55, to declutch end and install bearing spacer, pc #64.

   B. Install motor gearing by meshing drive shaft gear, pc #42, and intermediate pinion, pc #15, and pressing combined assembly into housing bores.

   C. Install motor gearing shims in motor adapter bearing bores and install motor adapter gasket, pc #34, and motor adapter, pc #3. Tap adapter to ensure bearings seat.

   D. Check intermediate pinion and shaft for proper shims.

   E. Install motor.

5. A. Install Spirolox ring, pc #106, on hollow drive shaft, pc #55.

   B. Install declutch housing, pc #2, using two screws only to compress Belleville spring set, pc #58.

   C. Utilizing two screws, thread cartridge stem nut, pc #48, on bearing cartridge stem, pc #45, until nut is snug against thrust washer, pc #46.

   D. Remove declutch housing and tighten cartridge stem nut set screw.

   E. Re-install declutch housing.

6. A. Install bearing mounting bracket assembly (pcs #8, #65, and #90).

   B. Install handwheel gear, pc #6, and Spirolox ring, pc #107.

   C. Install splined insert, pc #54, spring washer, pc #61, and clutch compression spring, pc #68.

7. A. Install sliding gear clutch, pc #51, onto hollow drive shaft splines, pc #55.

   B. Install drive shaft, pc #43, ensuring that gear clutch spacer, pc #47, is in place. Align splines on drive shaft and drive shaft gear and push drive shaft into unit from declutch end.

8. Mount bearings, pcs #94 and #97, on handwheel shaft and pinion, pc #40, and install assembly into unit.

9. A. Install declutch shaft, pc #30, and torsion spring, pc #57, into declutch cap, pc #59.

   B. Install declutch shaft assembly through bottom of declutch housing, pc #2. Declutch shaft assembly consists of declutch shaft, torsion spring, declutch cap, drum, pc #27, declutch arm, pc #66, declutch shaft washers, pc #70 (3 pcs), declutch fork, pc #14, declutch shaft spacer, pc #69, and collar, pc #103.

   NOTE: Declutch shaft must be installed with keyseat facing right side of declutch housing when viewed from declutch end of unit.

   C. Fasten declutch cap.

   D. Insert roll pin, pc #110, through declutch arm and shaft.

   E. Ensure that declutch shaft bears against declutch cap, push collar against top of housing and tighten collar set screw.

10. A. Ensure that oil seal, pc #105, is in place.

    B. Install declutch lever, pc #9, and tighten set screw.

    C. Rotate declutch lever clockwise, hold in position, and install declutch lever stop, pc #28.

11. A. Install clutch trippers, pc #33, pc #34, and tripper spring, pc #67.

    B. Install declutch housing cover, pc #4, and gasket, pc #82.

    C. Ensure that handwheel oil seal, pc #108, is in place.

    D. Install worm shaft end cap, pc # , and gaskets, pc #83.

    NOTE: Ensure that same number of gaskets are installed as were removed during disassembly. Thickness of gaskets must be sufficient to prevent end cap from bearing on drive shaft.

12. A. Install worm gear, pc #17.

    B. Install torque drive sleeve, pc #11, and drive sleeve thrust bearing, pc #19.

    C. Apply fresh, clean lubricant in unit housing (approximately 90 pounds).

    D. Install housing cover gasket, pc #79, and housing cover, pc #3.

13. Install handwheel clutch, pc #13, handwheel, pc #10, and handwheel washer, pc #60, on handwheel shaft, pc #40.

14. A. Install torque switch, pc #116, and geared limit switch, pc #117.

    B. Connect motor leads and leads to torque switch and geared limit switch.

SMB-5 & SMB-5T
REASSEMBLY OF VALVE OPERATOR

SMB-5 (Thrust Unit Only):

B1. If thrust adapter assembly pc #125 was not disassembled, continue to Step B2.

NOTE: Thrust bearing races should be pressed on thrust drive sleeve pc #126 and in thrust adapter housing pc #125 and thrust bearing cartridge pc #128 prior to beginning assembly procedure.

A. Install lower bearing roller assembly pc #131 in thrust adapter housing pc #125.

B. Install short end of thrust drive sleeve pc #126 into thrust adapter housing pc #125.

C. Install upper bearing roller assembly pc #131 on thrust drive sleeve pc #126.

D. Install thrust bearing cartridge pc #128 thread in tight or until drag is felt on thrust drive sleeve and tighten set screw.

E. Install oil seal pc #132 and seal retainer plate pc #129.

B2. Lift unit or turn upside down and install housing thrust adapter assembly pc #125. Ensure that thrust drive sleeve O ring pc #104 is in place.

B3. Install stem nut pc #127.

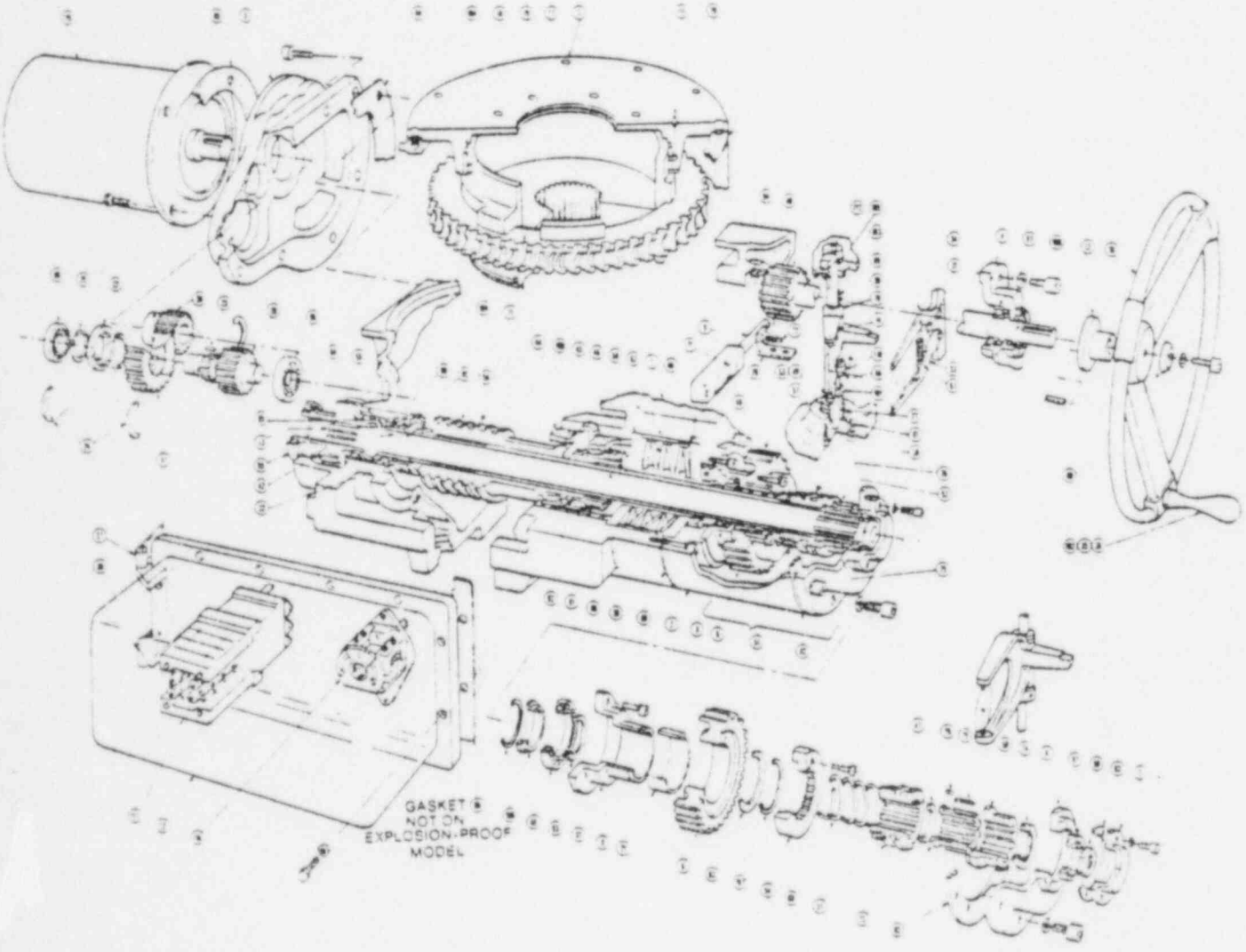
B4. Install drive sleeve locknut pc #100 and crimp or stake the top threads in two places.

WARNING! SMB-5 drive sleeve locknut has left hand threads and must be rotated counter-clockwise to install.

PC NO	DESCRIPTION
1	HOUSING
2	DECLUTCH HOUSING
3	HOUSING COVER
4	DECLUTCH HOUSING COVER
5	MOTOR ADAPTER
6	HANDWHEEL GEAR
7	WORM SHAFT END CAP
8	GEAR MOUNTING BRACKET
9	DECLUTCH LEVER
10	HANDWHEEL 30"
11	TORQUE DRIVE SLEEVE
12	LIMIT SWITCH COMPT COVER
13	HANDWHEEL CLUTCH
14	FORK
15	INTERMEDIATE PINION AND SHAFT
17	WORM GEAR
18	DRIVE SLEEVE BUSHING
19	DRIVE SLEEVE THRUST BEARING
20	WORM BUSHING
21	BUSHING - HANDWHEEL GEAR
27	DECLUTCH LEVER DRUM
28	DECLUTCH LEVER STOP
30	DECLUTCH SHAFT
31	TRIPPER BOLT
32	3/8" THREADED COLLAR
33	CLUTCH TRIPPER #1
34	CLUTCH TRIPPER #2
35	HANDLE ROD
36	HANDLE CHROME PLATE
37	HINGE - UPPER
38	HINGE - LOWER
39	MOTOR PINION
40	HANDWHEEL SHAFT & PINION
41	MOTOR DRIVE INTERMEDIATE GEAR
42	DRIVE SHAFT GEAR
43	DRIVE SHAFT (SOLID)
44	BEARING CARTRIDGE CAP
45	BEARING CARTRIDGE STEM
46	THRUST WASHER
47	GEAR CLUTCH SPACER
48	NUT - CARTRIDGE STEM
49	FORK - ROLLER
50	FLEXIBLE JAW CLUTCH HOUSING
51	SLIDING GEAR CLUTCH
52	MOTOR CLUTCH GEAR CAM PIN
53	PIN FORK ROLLER
54	SPLINED INSERT
55	HOLLOW DRIVE SHAFT
56	WORM
57	TORSION SPRING
58	BELLEVILLE SPRING
59	DECLUTCH CAP
60	WASHER - HANDWHEEL

PC NO	DESCRIPTION
61	SPRING WASHER
62	TORQUE LIMIT SLEEVE
63	HANDWHEEL GEAR SPACER
64	BEARING SPACER
65	BEARING ADAPTER
66	DECLUTCH ARM
67	TRIPPER SPRING
68	CLUTCH COMPRESSION SPRING
69	DECLUTCH SHAFT SPACER
70	DECLUTCH SHAFT WASHER
71	DECLUTCH LEVER NAME PLATE
72	STOP STUD
73	FLEXIBLE JAW CLUTCH SLEEVE
74	FLEXIBLE JAW CLUTCH COLLAR
75	NYLON INSERT
76	INTERNAL SPACER
79	HOUSING COVER GASKET
80	DECLUTCH HOUSING GASKET
81	DECLUTCH CAP GASKET
82	DECLUTCH COVER GASKET
83	WORM SHAFT END CAP GASKET
84	MOTOR ADAPTER GASKET
85	GASKET MOTOR
86	LIMIT SWITCH COVER GASKET
90	BEARING CONE
91	BEARING CUP
92	BEARING SPACER
93	BEARING
94	HANDWHEEL SHAFT BEARING
95	BEARING
96	BEARING
97	BEARING
98	BEARING LOCKNUT
99	BEARING LOCKNUT
100	BEARING LOCKNUT W/CUP PT
101	ROLL PIN 1/4" x 1 1/4"
102	RETAINING RING
103	HALLOWELL COLLAR W/ BORE
104	O RING
105	OIL SEAL
106	SPIROLOX RING
107	SPIROLOX RING
108	OIL SEAL
109	GROOVE PIN
110	ROLL PIN
111	GREASE FITTING
112	WELSH PLUG
113	MOTOR
116	TORQUE SWITCH
117	GEAR LIMIT SWITCH
124	HOUSING COVER
125	HOUSING THRUST ADAPTER
126	THRUST DRIVE SLEEVE
127	STEM NUT
128	THRUST BEARING CARTRIDGE
129	SEAL RETAINER PLATE
130	DRIVE SLEEVE LOCKNUT
131	THRUST BEARING
132	OIL SEAL
133	GREASE FITTING
134	O RING
135	GASKET
136	GASKET
137	THREADED FLANGE
138	DYNA-SEAL WASHER
139	BEARING CUP
140	BEARING CONE

SMB-5 & SMB-5T



SMB-5T

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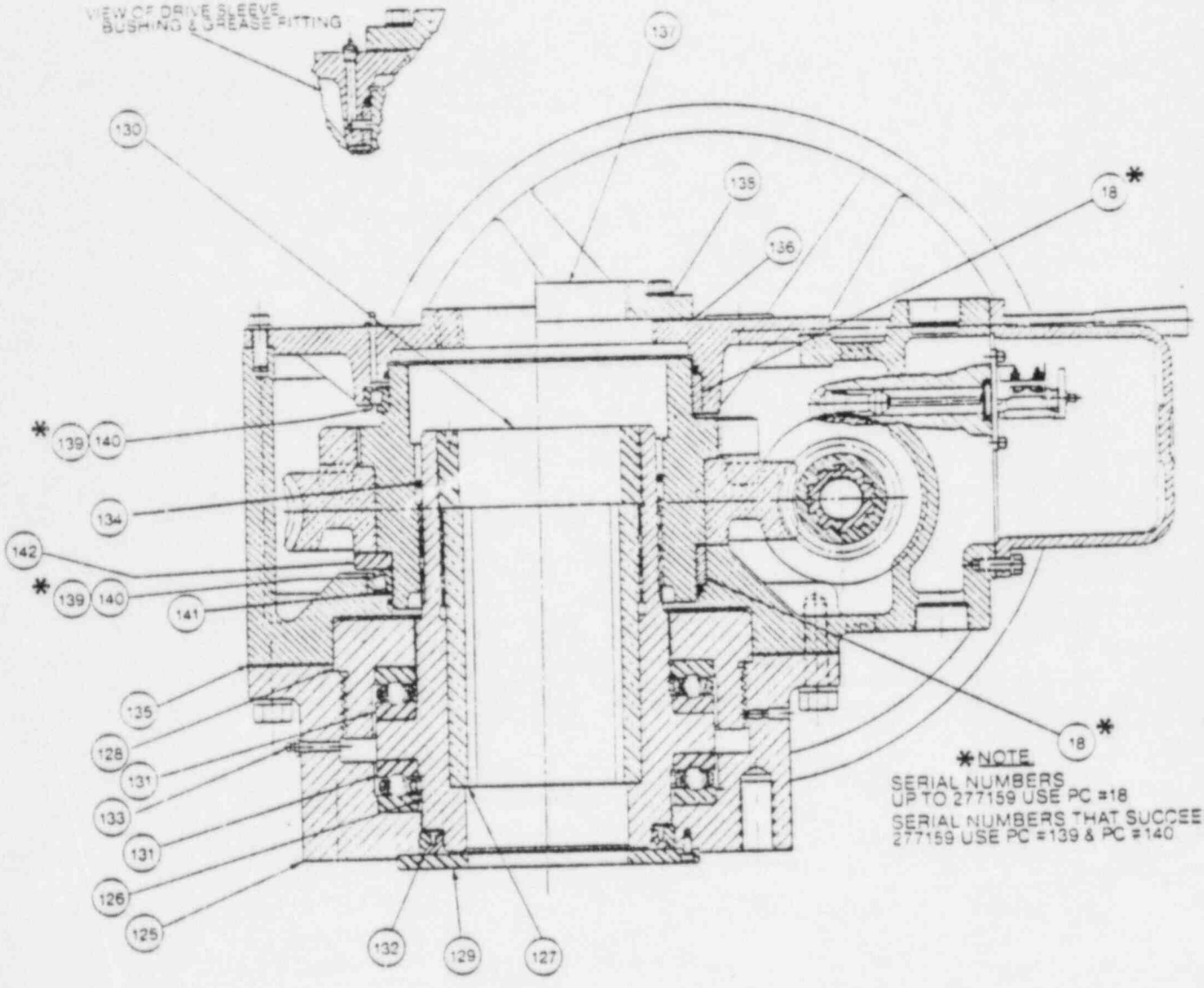
SMB-5 & SMB-5T



THRUST ASSEMBLY

01-413-0060-4

SB-00

DISASSEMBLY/ASSEMBLY/STEM NUT REMOVAL

General:

The SB-00 actuator is a basic SMB-00 unit with the housing cover, drive sleeve and locknut changed or modified to provide spring compensation to the stem nut. The disassembly/assembly procedure for the SMB-00 is applicable with the following procedure replacing Step 10 and stem nut removal procedure.

Disassembly/ Stem Nut Removal:

1. Remove compensator spring housing cover, pc #121.

2. Remove locknut, pc #125. Note that set screw, pc #126, must be loosened before locknut can be removed.

3. Lift compensator spring cartridge, pc #123. Try to keep cartridge straight to aid in its removal. The Belleville springs, pc #108, and thrust washer, pc #124, and thrust limiter sleeve, pc #119 (where applicable), will come out with the spring cartridge. Take note of the arrangement of the Belleville washers.

4. If the actuator is mounted on the valve, place unit in manual and rotate the handwheel in the direction to effect a downward movement of the stem (usually the closed direction) until the compensator bearing stops rising.

4A. If the actuator is not on a valve the stem nut will lift out after step 5.

5. Lift compensator bearing cartridge, pc #120, complete with bearing, pc #81.

6. Remove compensator spring housing, pc #96, as an assembly complete with side mounted handwheel assembly.

7. To remove drive sleeve assembly, proceed as in standard SMB-00 instructions.

Assembly/ Stem Nut Installation:

1. If actuator is not on valve, drop stem nut in place and insure that splines engage properly.

1A. If actuator is on the valve, thread the stem nut onto the stem until the splines hit.

A. Replace the compensator spring housing, pc #96, assembly as removed in Step 6.

B. Place unit in manual operation and rotate handwheel in the direction to effect an upward movement of the stem (usually the opening direction). Continue rotating until the stem begins to move upward.

2. Remove compensator spring housing, pc #96.

3. Install compensator bearing cartridge, pc #120, complete with bearing, pc #81, insuring seal, pc #116, is properly installed.

4. Clean bottom surface of mounting flange for compensator spring housing, pc #96, and main gear box housing, pc #1.

5. Place compensator spring housing, pc #96, in position without any gasket between it and the main housing, pc #1.

A. Measure the gap between the compensator spring housing and the main housing.

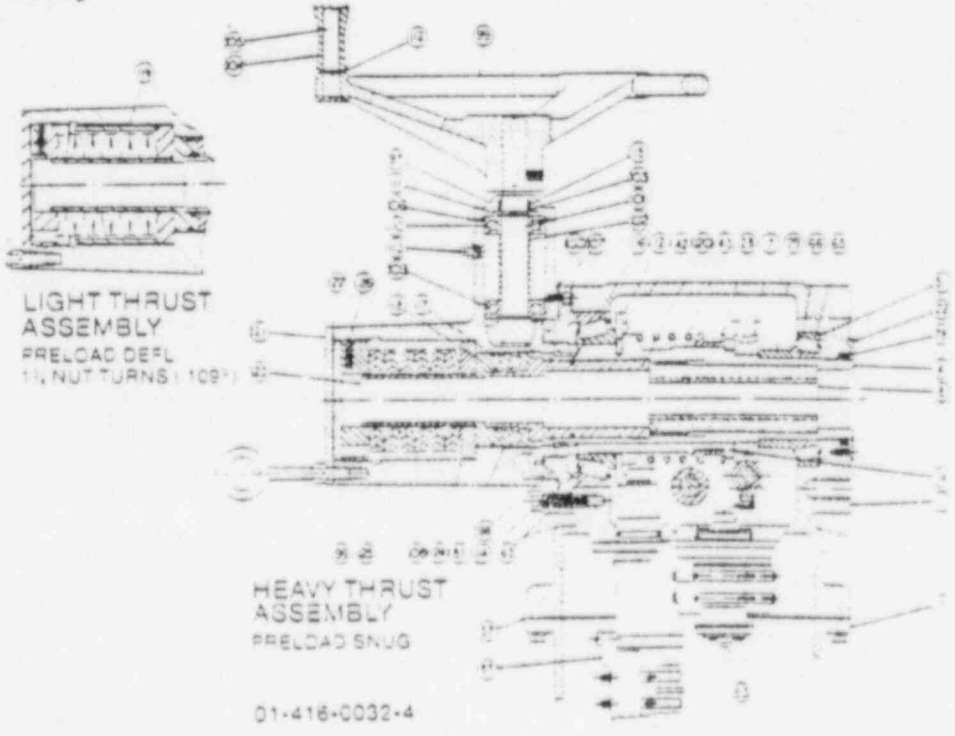
B. Install a gasket of the same thickness as the gap measured in (A) allowing for the compressibility of the gasket material. If the exact thickness gasket is not available, use the next larger thickness.

6. Install compensator spring cartridge, pc #123, complete with thrust washer, pc #124, Belleville springs, pc #108, and seals, pcs #117 and #118. The springs should be stacked in the same fashion as was noted in Step 3 of the disassembly procedure. The standard arrangement has the Belleville washers stacked in pairs as shown (see note).

7. Install locknut, pc #125, and tighten until it is snug (see note) against the Belleville springs. Secure by tightening set screw, pc #126.

8. Install compensator spring housing cover, pc #121.

NOTE: The SB-00 has available an optional very light Belleville spring set consisting of 11 washers arranged as shown in the view at the top of the drawing. Insure you reinstall correctly. The light spring set also has a thrust limiter sleeve, pc #119, which is installed at this point. When the light spring set is used, the locknut installed in next step must be pulled up snug against the spring set and then tightened an additional 1-3/4 turns to preload the springs.



SB-0

DISASSEMBLY/ASSEMBLY/STEM NUT REMOVAL

General:

The SB-0 actuator is a basic SMB-0 unit with the housing cover drive sleeve and locknut changed or modified to provide spring compensation to the stem nut. The disassembly/assembly procedure for the SMB-0 is applicable with the following procedure replacing Step 11 and stem nut removal procedure.

Disassembly/ Stem Nut Removal:

Special SB Spring Compensator Parts:

1. Remove compensator spring housing, pc #3.

2. Remove compensator spring cartridge, pc #106. The Belleville spring, pc #109 and spacer, pc #108, will come off with spring cartridge, pc #106.

3. Remove spring compensator bearing cartridge, pc #107, being careful not to loosen or damage seal, pc #94. Bearing, pc #116, will come out with bearing cartridge, pc #107.

4. To remove drive sleeve—proceed as Step 11 of SMB-0 standard instructions. If only the stem nut is to be removed proceed to Step 5.

5. The stem nut, pc #20, is now accessible and can be lifted directly from the actuator provided the actuator is not on the valve. If the actuator is on the valve, the stem nut may be removed by bolting a support ring or bar across the top of the main housing of the actuator to hold thrust bearing, pc #78, in place. After this is done, the actuator could be placed in hand operation and the handwheel rotated in the direction to effect a downward movement of the stem (usually the close direction). The stem nut will then climb up the stem until it clears its splines. The stem nut can then be rotated off the stem.

Reassembly/ Stem Nut Installation:

1. Replace the stem nut, pc #20. If the actuator is not on the valve, the stem nut will drop in the drive sleeve, pc #11, until it bottoms out on the shoulder in the bottom of the drive sleeve. Insure splines are engaged. If the actuator is mounted on the valve, the stem nut, pc #20, can be installed by threading the stem nut down the stem until the splines hit. Put the actuator in manual operation and rotate the handwheel in the direction to move the stem upward (usually the open direction). The stem nut will lower as the handwheel turns, until it bottoms out on the shoulder in the bottom of the drive sleeve and the stem starts to move up.

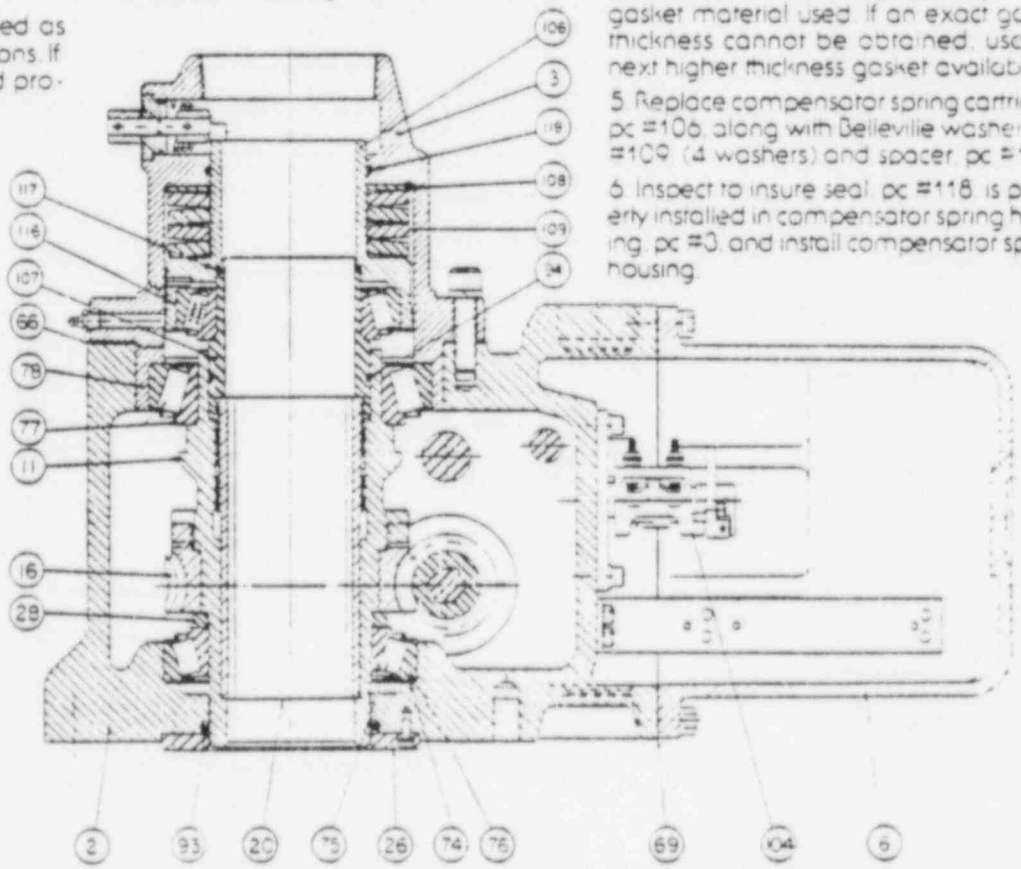
2. Replace bearing cartridge, pc #107 and bearing, pc #116, insuring seals, pcs #117 and #94, are properly installed. Insure bearing cartridge engages the splines on the top of the stem nut (cartridge will not rotate if engaged properly).

3. Clean main housing, pc #2, flange and mounting flange of the compensator spring housing, pc #3. Install compensator spring housing without any gasket. Measure the gap between the compensator spring housing, pc #3, and the main housing, pc #2.

4. Remove compensator spring housing, pc #3, and install a gasket between main housing and compensator spring housing. The gasket thickness should be the same as the gap measured in Step 3, plus an allowance for the compressibility of the gasket material used. If an exact gasket thickness cannot be obtained, use the next higher thickness gasket available.

5. Replace compensator spring cartridge, pc #106, along with Belleville washers, pc #109, (4 washers) and spacer, pc #108.

6. Inspect to insure seal, pc #118, is properly installed in compensator spring housing, pc #3, and install compensator spring housing.



01-416-0027-4

SB-1

DISASSEMBLY/ASSEMBLY/STEM NUT REMOVAL

General:

The SB-1 actuator is a basic SMB-1 unit with the housing cover drive sleeve and locknut changed or modified to provide spring compensation to the stem nut. The disassembly/assembly procedure for the SMB-1 is applicable with the following procedure replacing Step 11 and stem nut removal procedure.

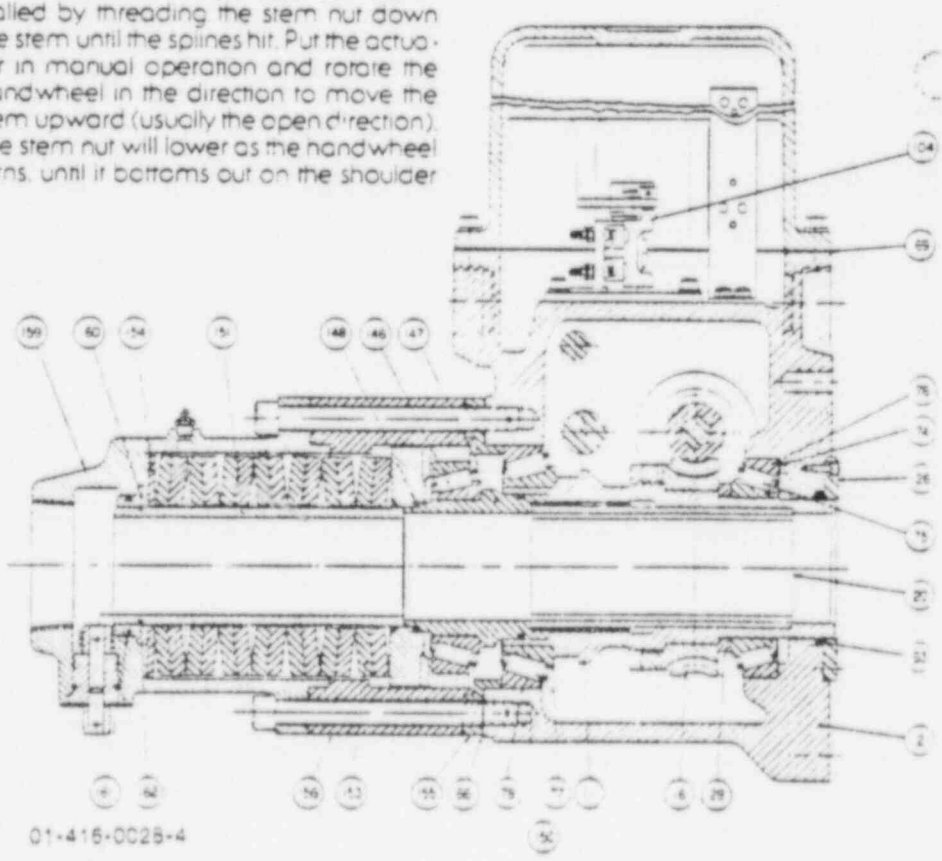
Disassembly/ Stem Nut Removal:

Special SB Spring Compensator Parts:

1. Remove compensator spring housing, pc #159.
2. Remove compensator spring housing spacer, pc #156.
3. Remove compensator spring cartridge, pc #151. The Belleville springs, pc #153, and spacer, pc #154, will come off with spring cartridge.
4. Remove spring compensator bearing cartridge, pc #147, being careful not to loosen or damage seal, pc #150. Bearing, pc #146, will come out with bearing cartridge, pc #147.
5. To remove drive sleeve—proceed as Step 11 of standard SMB-0 instructions after removing housing cover, pc #155. If only the stem nut is to be removed, proceed to Step 6.
6. The stem nut, pc #20, is now accessible and can be lifted directly from the actuator provided the actuator is not on the valve. If the actuator is on the valve, the stem nut may be removed by bolting housing cover, pc #155, to housing using two 5/8 x 11 UN x 1-1/4 bolts. After this is done, the actuator could be placed in hand operation and the handwheel rotated in the direction to effect a downward movement of the stem (usually the close direction). The stem nut will then climb up the stem until it clears its splines. The stem nut can then be rotated off the stem.

Reassembly/ Stem Nut Installation:

1. Replace the stem nut, pc #20. If the actuator is not on the valve, the stem nut will drop in the drive sleeve, pc #11, until it bottoms out on the shoulder in the bottom of the drive sleeve. Insure splines are engaged. If the actuator is mounted on the valve, the stem nut, pc #20, can be installed by threading the stem nut down the stem until the splines hit. Put the actuator in manual operation and rotate the handwheel in the direction to move the stem upward (usually the open direction). The stem nut will lower as the handwheel turns, until it bottoms out on the shoulder in the bottom of the drive sleeve and the stem starts to move up.
2. Replace bearing cartridge, pc #147, and bearing, pc #146, insuring seals, pcs #148 and #150, are properly installed. Insure bearing cartridge engages the splines on the top of the stem nut (cartridge will not rotate if engaged properly).
3. Replace compensator spring cartridge, pc #151, along with Belleville washers, pc #153, (14 washers), and spacer, pc #154. Insure Belleville washers are stacked as indicated in drawing 01-416-0028-4. Insure seal, pc #162, is installed in spring cartridge.
4. Install compensator spring housing spacer, pc #156, using a 1/32" gasket.
5. Insure cartridge guide bushing, pc #160, and seal, pc #161, are properly installed in compensator spring housing, pc #159.
6. Install compensator spring housing, pc #159, using a 1/32" gasket.



01-416-0028-4

SB-2
DISASSEMBLY/ASSEMBLY/STEM NUT REMOVAL

General:

The SB-2 actuator is a basic SMB-2 unit with the housing cover, drive sleeve and locknut changed or modified to provide spring compensation to the stem nut. The disassembly/ assembly procedure for the SMB-2 is applicable with the following procedure replacing Step 11 and stem nut removal procedure.

Disassembly/ Stem Nut Removal:

Special SB Spring Compensator Parts:

1. Remove compensator spring housing cover, pc #161.

2. Remove compensator spring cartridge, pc #170, complete with Belleville springs, pc #179, thrust washers, pc #178, limiter sleeve, pc #199, and locknut, pc #180. (See note for further disassembly.)

3. Remove spring compensator bearing cartridge, pc #168, complete with bearings, pc #169.

4. Remove compensator spring housing, pc #163. (Read Step 6 before removing.)

5. To remove drive sleeve, proceed as Step 12 of standard SMB-0 instructions. If the stem nut is to be removed, proceed to Step 6.

6. The stem nut, pc #20, is now accessible and can be lifted directly from the actuator provided the actuator is not on the valve. The stem nut may be removed by leaving or reinstalling spring housing, pc #163. The stem nut may also be removed by bolting a support ring or bar across the top of the main housing of the actuator to hold thrust bearing, pc #78, in place. After this is done, the actuator could be placed in hand operation and the handwheel rotated in the direction to effect a downward movement of the stem (usually the close direction). The stem nut will then climb up the stem until it clears its splines. The stem nut can then be rotated off the stem.

Reassembly/ Stem Nut Installation:

1. Replace the stem nut, pc #20. If the actuator is not on the valve, the stem nut will drop in the drive sleeve, pc #11, until it bottoms out on the shoulder in the bottom of the drive sleeve. Insure splines are engaged. If the actuator is mounted on the valve, the stem nut, pc #20, can be installed by threading the stem nut down the stem until the splines hit. Put the actuator in manual operation and rotate the handwheel in the direction to move the stem upward (usually the open direction). The stem nut will lower as the handwheel turns, until it bottoms out on the shoulder in the bottom of the drive sleeve and the stem starts to move up.

2. Replace bearing cartridge, pc #168, and bearing, pc #169, insuring seals, pcs #194 and #176, are properly installed. Insure bearing cartridge engages the splines on the top of the stem nut (cartridge will not rotate if engaged properly).

3. Clean main housing, pc #2, flange, and mounting flange of the compensator spring housing, pc #163. Install compensator spring housing without any gasket. Measure the gap between the compensator spring housing, pc #163, and the main housing, pc #2.

4. Remove compensator spring housing, pc #163, and install a gasket between main housing and compensator spring housing. The gasket thickness should be the gap measured in Step 3, plus an allowance for the compressibility of the gasket material used. If an exact gasket thickness cannot be obtained, use the next higher thickness.

5. Install compensator spring housing, pc #163.

6. Replace compensator spring cartridge, pc #170, as an assembly. Install seal, pc #197, in locknut.

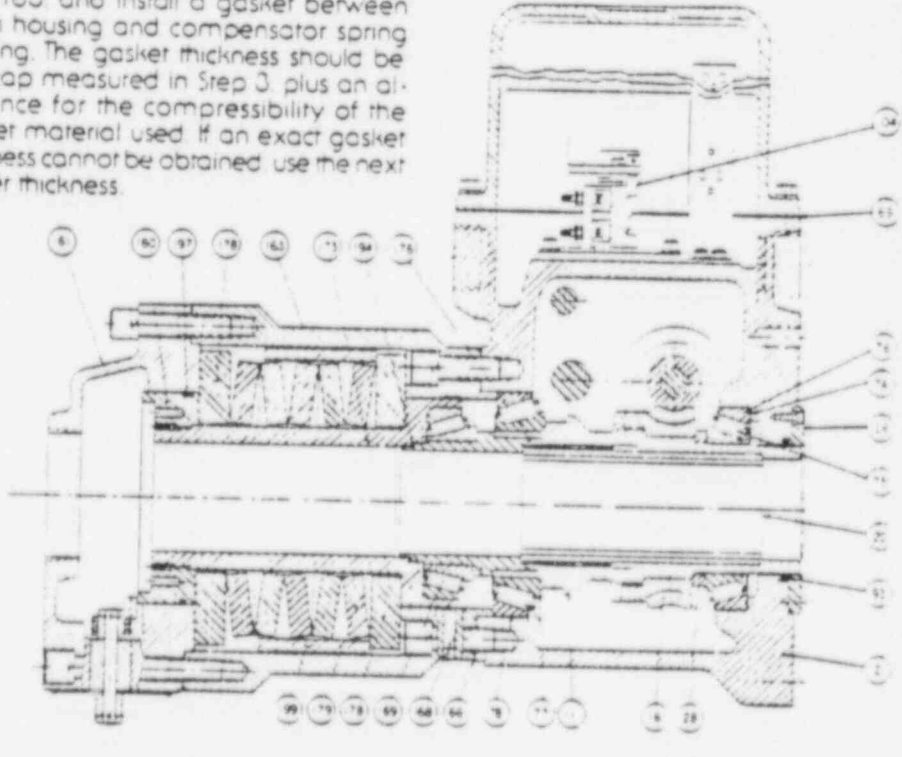
7. Install compensator spring housing cover, pc #161, using a gasket of sufficient thickness, including an allowance for compressibility, to fill any gap between the cover and the spring housing.

NOTE: The spring assembly should not be disassembled (unless absolutely necessary!) To disassemble the compensator spring cartridge:

1. Remove locknut, pc #180. Be careful to remove the set screws securing the locknut to the cartridge before trying to remove locknut.

2. Lift off thrust washer, pc #178, Belleville spring, pc #179 (5 washers), and thrust limiter sleeve, pc #199.

To reassemble, position Belleville springs, pc #179, as shown in drawing 01-416-0030-4 between the two thrust washers, pc #178. Thread locknut, pc #180, onto the compensator spring cartridge, pc #170, until it hits the shoulder on the cartridge. Reinstall set screws or drill and tap for new set screw locations.



SB-3

DISASSEMBLY/ASSEMBLY/STEM NUT REMOVAL

General:

The SB-3 actuator is a basic SMB-3 unit with the housing cover, drive sleeve and locknut changed or modified to provide spring compensation to the stem nut. The disassembly/assembly procedure for the SMB-3 is applicable with the following procedure replacing Step 11 and stem nut removal procedure.

Disassembly/ Stem Nut Removal:

Special SB Spring Compensator Parts

1. Remove compensator spring housing, pc #140.

2. Remove compensator spring cartridge, pc #149, complete with Belleville springs, pc #152, thrust washers, pcs #150 and #153, limiter sleeve, pc #161, and locknut, pc #166. (See note for further disassembly.)

3. Remove spring compensator bearing cartridge, pc #154, complete with bearing, pc #147.

4. Remove centering ring, pc #167.

5. The drive sleeve assembly can now be removed as per Step 11 of standard SMB-0 instructions. If the stem nut alone is to be removed, proceed as in Step 6.

6. The stem nut, pc #20, is now accessible and can be lifted directly from the actuator provided the actuator is not on the valve. If the actuator is on the valve, the stem nut may be removed by bolting the housing cover, pc #3, to the housing using two 7/8 x 9 UN x 1-1/2" bolts to hold thrust bearing, pc #78, in place. After this is done the actuator could be placed in hand operation and the handwheel rotated in the direction to effect a downward movement of the stem (usually the close direction). The stem nut will then climb up the stem until it clears its splines. The stem nut can then be rotated off the stem.

Reassembly/ Stem Nut Installation

1. Replace the stem nut, pc #20. If the actuator is not on the valve, the stem nut will drop in the drive sleeve, pc #11, until it bottoms out on the shoulder in the bottom of the drive sleeve. Insure splines are engaged. If the actuator is mounted on the valve, the stem nut, pc #20, can be installed by threading the stem nut down the stem until the splines hit. Put the actuator in manual operation and rotate the handwheel in the direction to move the stem upward (usually the open direction). The stem nut will lower as the handwheel turns, until it bottoms out on the shoulder in the bottom of the drive sleeve and the stem starts to move up.

2. Replace bearing cartridge, pc #154, and bearing, pc #147, insuring seals, pcs #168 and #169, are properly installed. Insure bearing cartridge engages the splines on the top of the stem nut (cartridge will not rotate if engaged properly).

3. Replace centering ring, pc #167.

4. Replace compensator spring cartridge, pc #149, as an assembly along with Belleville springs, pc #152 (10 washers), thrust washers, pcs #150 and #153, and locknut, pc #166.

5. Replace thrust limiter sleeve, pc #161.

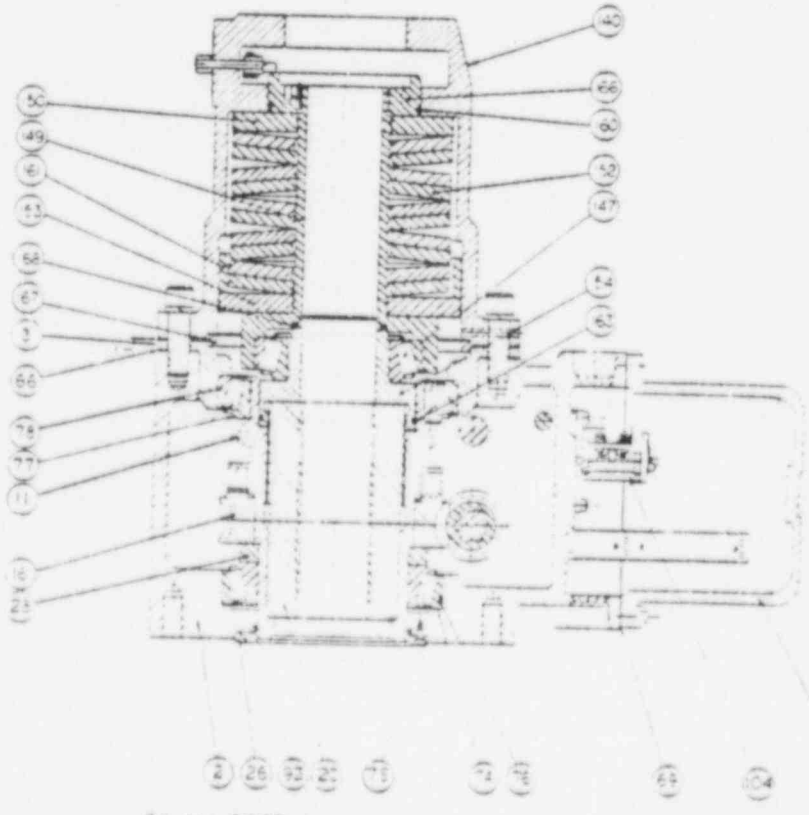
6. Inspect to insure seal, pc #160, is properly installed in locknut, pc #166 and install compensator spring housing, pc #140, adding a gasket of sufficient thickness to fill in the gap "x" making an allowance for the compressibility of the gasket material.

NOTE: The spring assembly should not be disassembled unless absolutely necessary! To disassemble the compensator spring cartridge:

1. Remove locknut, pc #166. Be careful to remove the set screws securing the locknut to the cartridge before trying to remove locknut.

2. Lift thrust washer, pc #150, Belleville spring, pc #152 (10 washers), and thrust washer, pc #153.

To reassemble, position Belleville springs, pc #152, between the thrust washer, pc #153 (bottom), and thrust washer, pc #150 (top), as shown in drawing 01-416-0029-4. Thread locknut, pc #166, onto the compensator spring cartridge, pc #154, until the locknut touches the thrust washer and then an additional 3/4 of a turn. Install set screws or drill and tap for new set screw locations.



SB-4

DISASSEMBLY/ASSEMBLY/STEM NUT REMOVAL

General:

The SB-4 actuator is a basic SMB-4 unit with the housing cover, drive sleeve and locknut changed or modified to provide spring compensation to the stem nut. The disassembly/assembly procedure for the SMB-4 is applicable with the following procedure replacing Step 11 and stem nut removal procedure.

Disassembly/ Stem Nut Removal:

Special SB Spring Compensator Parts:

1. Remove compensator spring housing, pc #163.

2. Remove thrust washer, pc #178.

3. Remove compensator spring cartridge assembly including pcs #180, #170, and #179.

4. Remove compensator bearing cartridge, pc #168. Bearing, pc #169, will come out with bearing cartridge.

5. The drive sleeve assembly can now be removed as per Step 12 of standard SMB-0 instructions. If stem nut alone is to be removed, proceed as in Step 6.

6. The stem nut, pc #20, is now accessible and can be lifted directly from the actuator provided the actuator is not on the valve. If the actuator is on the valve, the stem nut may be removed by bolting housing cover, pc #155, to housing using two 1" – 8UN x 2.5" LG bolts. After this is done the actuator could be placed in hand operation and the handwheel rotated in the direction to effect a downward movement of the stem (usually the close direction). The stem nut will then climb up the stem until it clears its splines. The stem nut can then be rotated off the stem.

Reassembly/ Stem Nut Installation:

1. Replace the stem nut, pc #20, and seal pc #182. If the actuator is not on the valve, the stem nut will drop in the drive sleeve, pc #11, until it bottoms out on the shoulder in the bottom of the drive sleeve. Insure splines are engaged. If the actuator is mounted on the valve, the stem nut, pc #20, can be installed by threading the stem nut down the stem until the splines hit. Put the actuator in manual operation and rotate the handwheel in the direction to move the stem upward (usually the open direction). The stem nut will lower as the handwheel turns, until it bottoms out on the shoulder in the bottom of the drive sleeve and the stem starts to move up.

2. Replace bearing cartridge, pc #168 and bearing, pc #169, insuring seals, pcs #175 and #176, are properly installed. Insure bearing cartridge engages the splines on the top of the stem nut. (cartridge will not rotate if engaged properly).

3. Replace compensator spring cartridge, pc #170, as an assembly with thrust washer, pc #178, installed in bottom and Belleville spring, pc #179 (4 washers) arranged as shown in drawing 01-416-0031-4 plus spring cartridge cover, pc #180, and seal, pc #181.

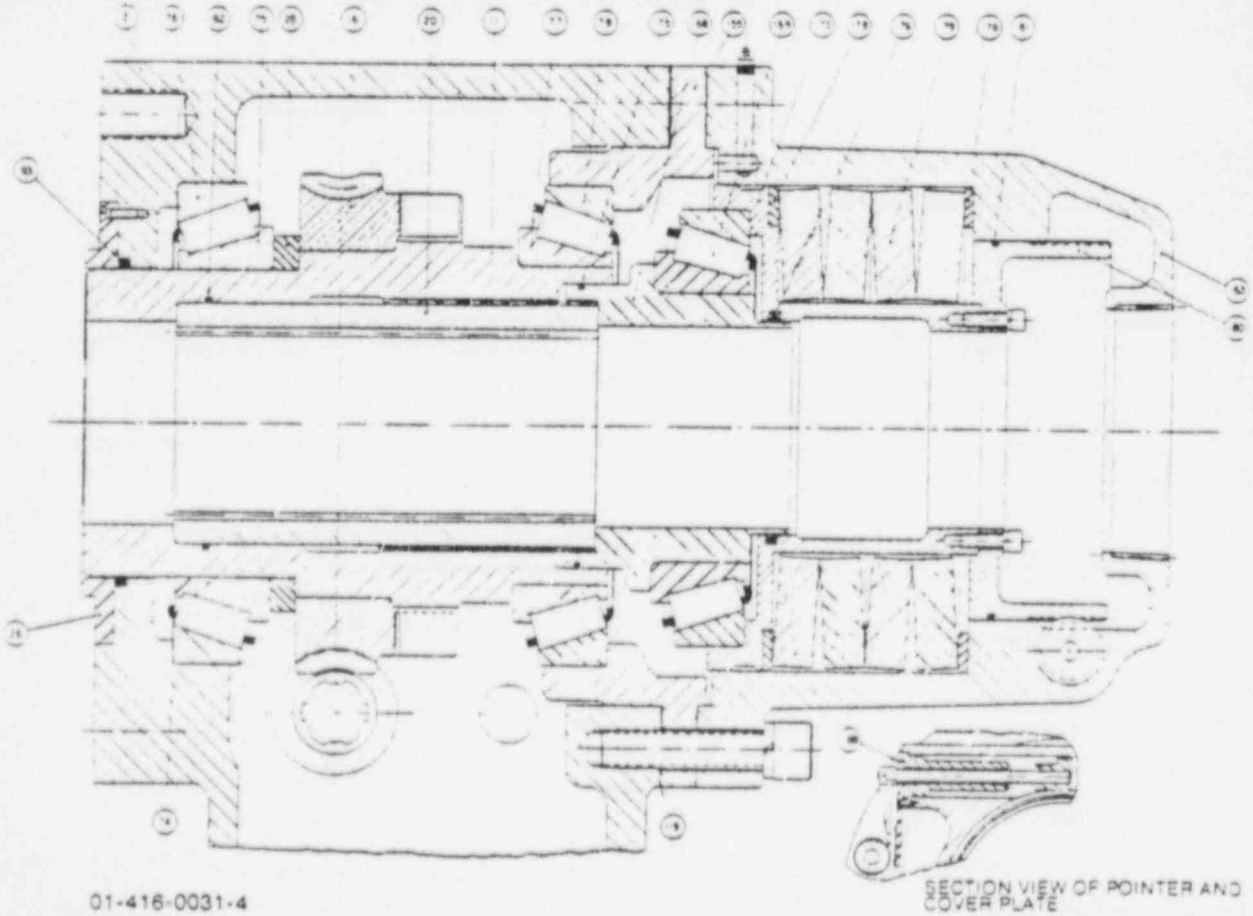
4. Replace thrust washer, pc #178, on the top of the spring cartridge.

5. Replace compensator spring housing, pc #163, with a 1/32" gasket.

6. To realign deflection indicator, remove cover plate, pc #188.

7. Pull pointer and pointer shaft out and move to "O" deflection.

8. Push pointer and pointer shaft back in and replace cover plate, pc #188.



01-416-0031-4

SECTION VIEW OF POINTER AND COVER PLATE

ELECTRICAL COMPONENTS

The Reversing Starter electrically changes the operation of the electric motor from one direction of rotation to the other and consists of 2 relay contactors mounted on a common base and mechanically interlocked. Each contactor consists of 3 normally open power contacts, 1 normally open control circuit holding contact, 1 normally closed electrical interlock and a magnetic holding coil. It may be mounted integrally with the Limitorque operator as shown on the back page of this bulletin or may be furnished as a separate unit.

The Overload Relays are electrical devices which function at a predetermined value of over current to de-energize the holding coils of the reversing contactor, thus opening the power contacts to de-energize the electric motor. They are of the automatic reset type when mounted as an integral part of the Limitorque operator.

If the reversing starter is furnished as a separately enclosed and separately mounted component, the overload relays are generally furnished with a manual reset. In some cases, if the overload relays trip before the electric motor operator closes the valve fully, it may be necessary to install larger relays having a higher current rating. Generally, the overload relays are sized based on the full load running current of the motor. However, depending on the actual installation, it may be necessary to change the original overload relays to the next higher current rating.

The Pushbutton Station usually consists of 3 buttons and 2 indicating lights. The pushbuttons are generally wired into the motor control circuit as shown on the schematic wiring diagrams indicated on another page. The pushbuttons are wired in series with the reversing starter holding coil. Therefore, when the pushbuttons are depressed, the reversing starter coil is energized to close the main power contacts to the electric motor, for the direction of rotation desired.

Whenever indicating lights are furnished, one light usually indicates full open position of the valve and the other light the full closed position. When both lights are burning, the valve is at the intermediate position. Other combinations of pushbuttons, lights and selector switches may be necessary for the specific application. The photograph on the back page shows a 3-position selector switch marked "open-stop-close".

Additional Electrical Troubleshooting

If the reversing starter contacts fail to close, check the line circuit breaker or fuses in the disconnect switch (if installed) for possible interruption of incoming line voltage. The holding coil may be open-circuited and, if so, should be replaced.

The pushbutton contacts should be checked to insure that they are making proper contact when depressed. They should be adjusted for correct movement and proper contact pressure. If the overload relay contacts are open they should be reset. Continued tripping of the overload relay usually indicates trouble with the motor or improper sizing of overload heater (see electric motor nameplate for full load current).

Always check for damaged or worn mechanical parts which might restrict the movement of the motor reversing starter. All parts should be cleaned, adjusted, and aligned for free movement. Any defective ones should be replaced. When replacing contacts, the complete set of moving and stationary contacts should be changed along with springs to assure proper contact pressure. Trace out connection of pushbutton contacts with the wiring diagram for the actual installation. Pushbutton contacts may stick and should be adjusted for free movement and normal contact pressure. A check of the wiring should be made for "sneak-in" or grounded circuits and defective insulation.

Whenever Space Heaters are provided in the limit switch compartment and it becomes necessary to replace them, the following is a list of the size heaters to be used for various voltages.

Voltage	Watts	Resistance (Ohms)
110/120	25	500/750
208/220	25	2100
380	25	7200
440	25	8500
550	25	15,000

ELECTRICAL COMPONENTS

Remote Position Indicators

Setting and Installation Instructions/ Slidewire Type Position Indicator:

CAUTION: The voltmeter indicator is built to accept a maximum of ten (10) volts only. Therefore, it will be necessary to use a separate test voltmeter with a scale suitable for the maximum incoming control voltage.

1. Refer to P.G.C. Wiring Diagram 15-477-0180-1.

2. Mount the adjustable resistor as near as possible to the voltmeter indicator.

3. WITH POWER OFF connect all wires as shown on the W/D except the two on the voltmeter indicator; connect these two to the test meter. (see caution above).

4. Move the slider of the adjustable resistor to the extreme opposite end of the resistor from the power connection.

5. Open the indicator compartment of the Limitorque unit and uncouple transmitter shaft from gearing.

6. Operate Limitorque to a fully closed position of the valve.

7. Rotate wiper arm of transmitter to the zero degree position and recouple shaft.

8. Turn POWER ON. Test meter should now read "zero" or almost zero.

9. Run or crank unit to the fully open position.

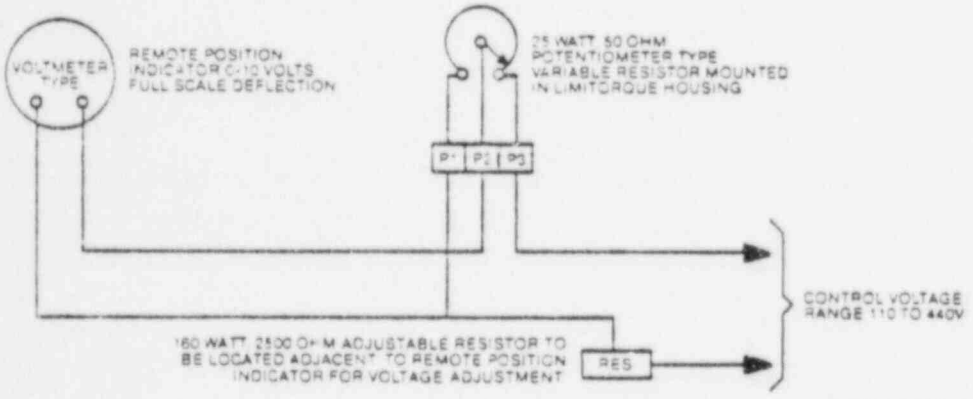
10. Move the adjustable resistor slider toward the power connected end until the test meter reads ten (10) volts.

11. Turn Power Off — Disconnect the test meter and connect the leads to the voltmeter indicator.

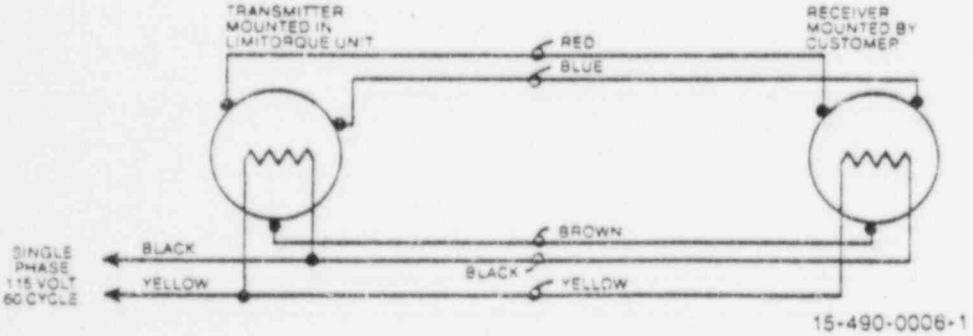
12. Turn Power On — Indicator should now read full open.

13. Final adjustment may be necessary. If indicator reads less than full open move the adjustable resistor slider ahead slightly being careful not to exceed full open position on the dial. If meter reads more than zero, when unit is fully closed repeat setting starting with step #7.

14. After setting indicator, lock adjustable resistor slider in place.



15-477-0183-1



15-490-0006-1

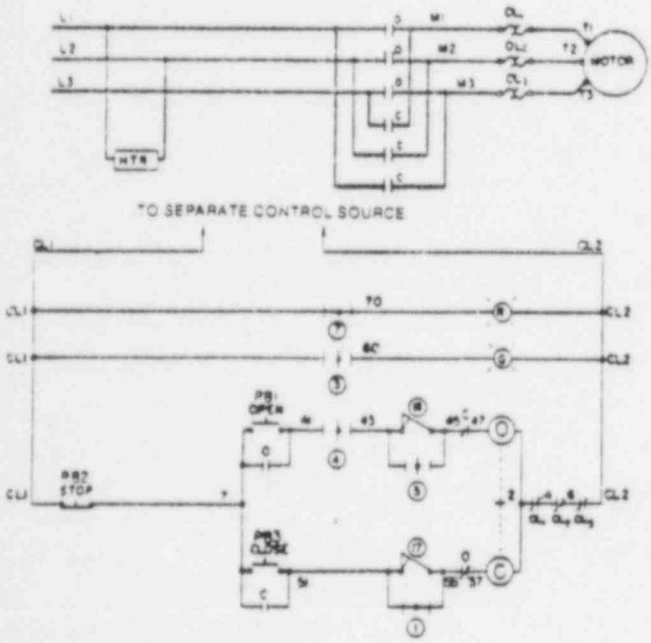
SELSYN TYPE POSITION TRANSMITTER WIRING DIAGRAM

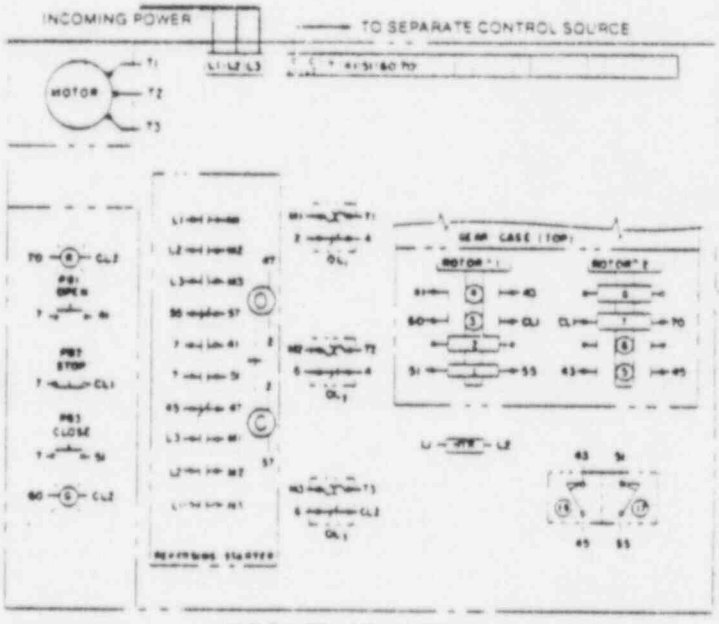
TYPICAL WIRING DIAGRAMS

The following drawings are typical Limitorque wiring diagrams showing built in motor controls for a 3 phase power supply for the electric motor. In the first drawing, the arrangement is a typical one for a wedge type gate valve or globe valve where the closing direction is limited by the torque switch, and the opening direction is limited by the geared limit switch.

The second drawing is one which could be used in controlling the opening and closing of butterfly valves, ball valves, plug valves or sluice gates where the closing and opening directions are limited by the geared limit switch. The torque switches are wired in series with the geared limit switches to protect against mechanical overloads anywhere between full open and closed positions of the valve.

Both arrangements are shown with a three button (open, stop, close) pushbutton setup, and two lights to indicate full open or close positions of the valve. When the valve is at some intermediate position of travel, both lights will be on.





15-476-0055-3

VALVE SHOWN IN FULL OPEN POSITION

LIMIT SWITCH COMPARTMENT				
MOTOR	CONTACT	VALVE POSITION: FULL OPEN	VALVE POSITION: FULL CLOSED	FUNCTION
1	1	----------		BY PASS 17
	2	----------		SPARE
	3		----------	OPEN LIGHT
2	1	----------		BY PASS 18
	2	----------		SPARE
	3		----------	CLOSE LIGHT
	4			SPARE

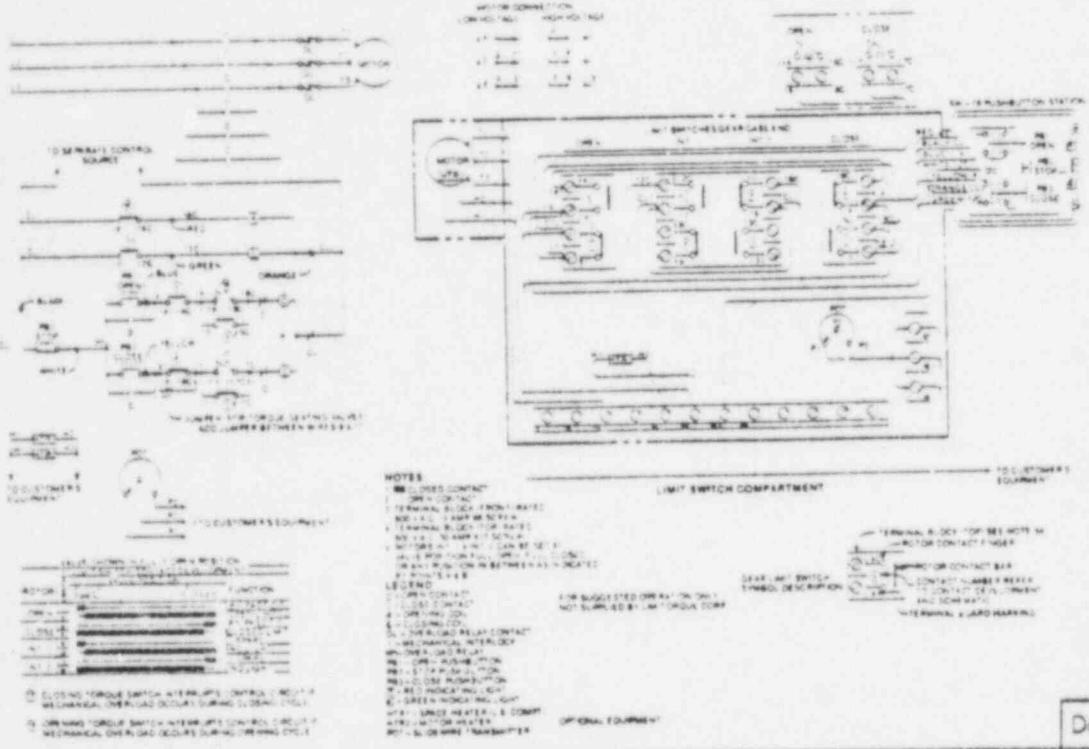
NOTES
1 ——— CLOSED CONTACT
2 - - - OPEN CONTACT

(17) CLOSING TORQUE SWITCH INTERRUPTS CONTROL CIRCUIT IF MECHANICAL OVERLOAD OCCURS DURING CLOSING CYCLE OF FULLY CLOSED VALVE

(18) OPENING TORQUE SWITCH INTERRUPTS CONTROL CIRCUIT IF MECHANICAL OVERLOAD OCCURS DURING OPENING CYCLE

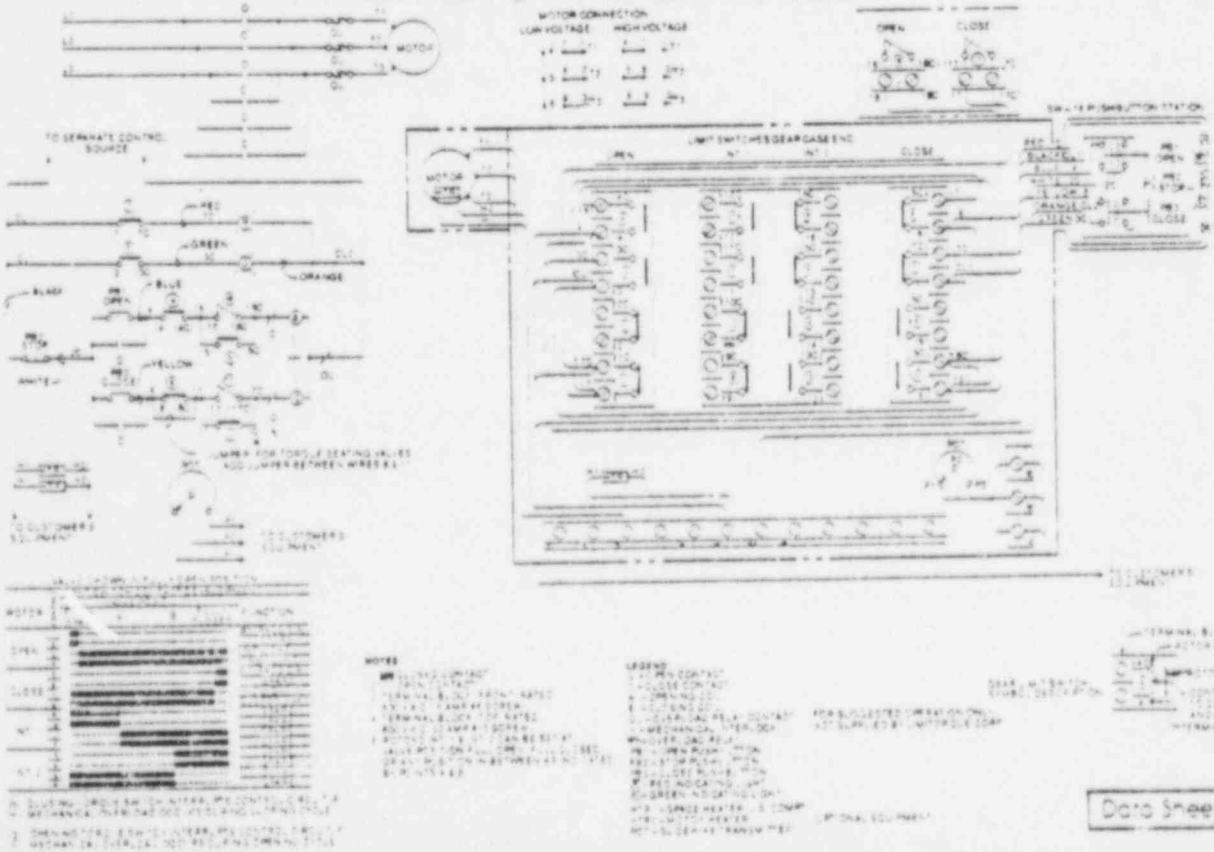
WIRING DIAGRAMS

UNIT WITH SW PUSH BUTTON STATION
4 ROTOR/2 CONTACT



Data Sheet SMC-20[illegible]

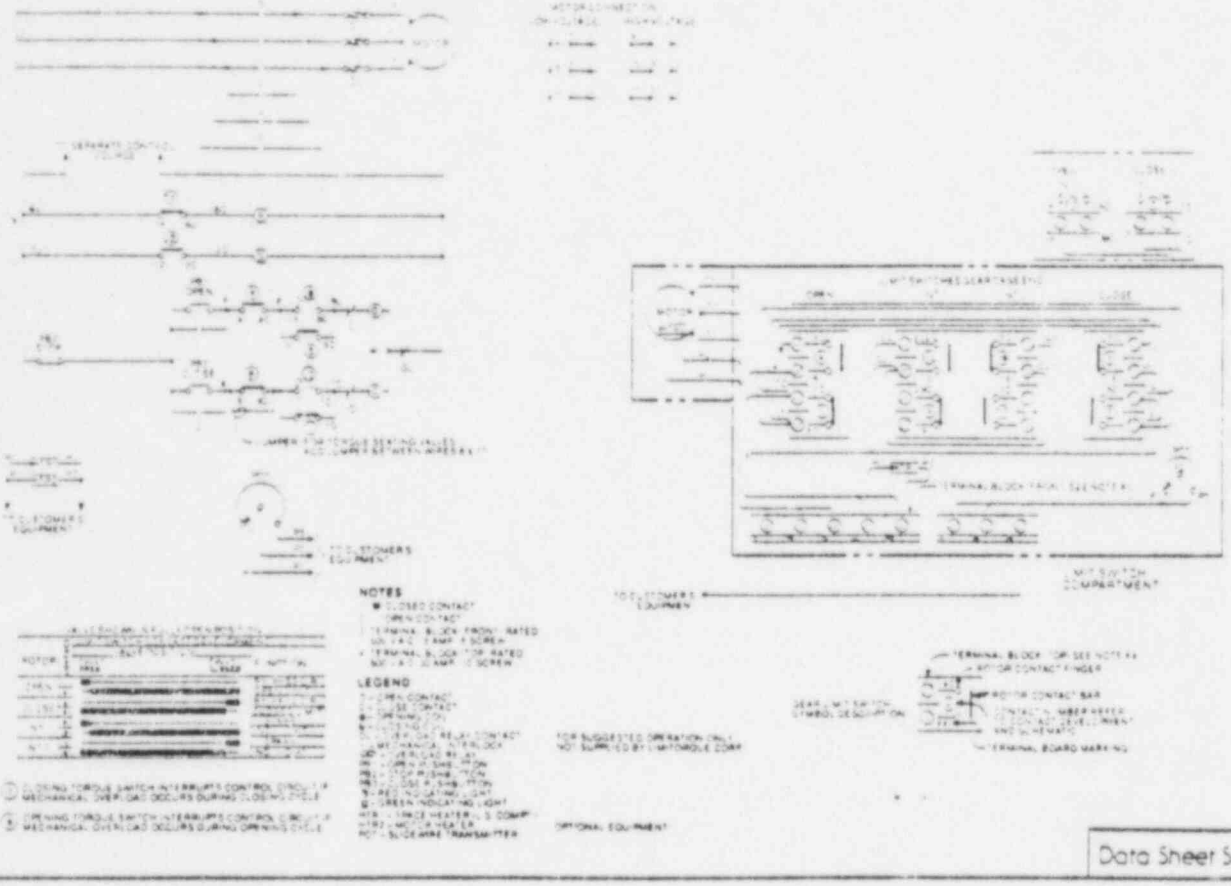
UNIT WITH SW PUSH BUTTON STATION
4 ROTOR/4 CONTACT



Data Sheet SMC-200

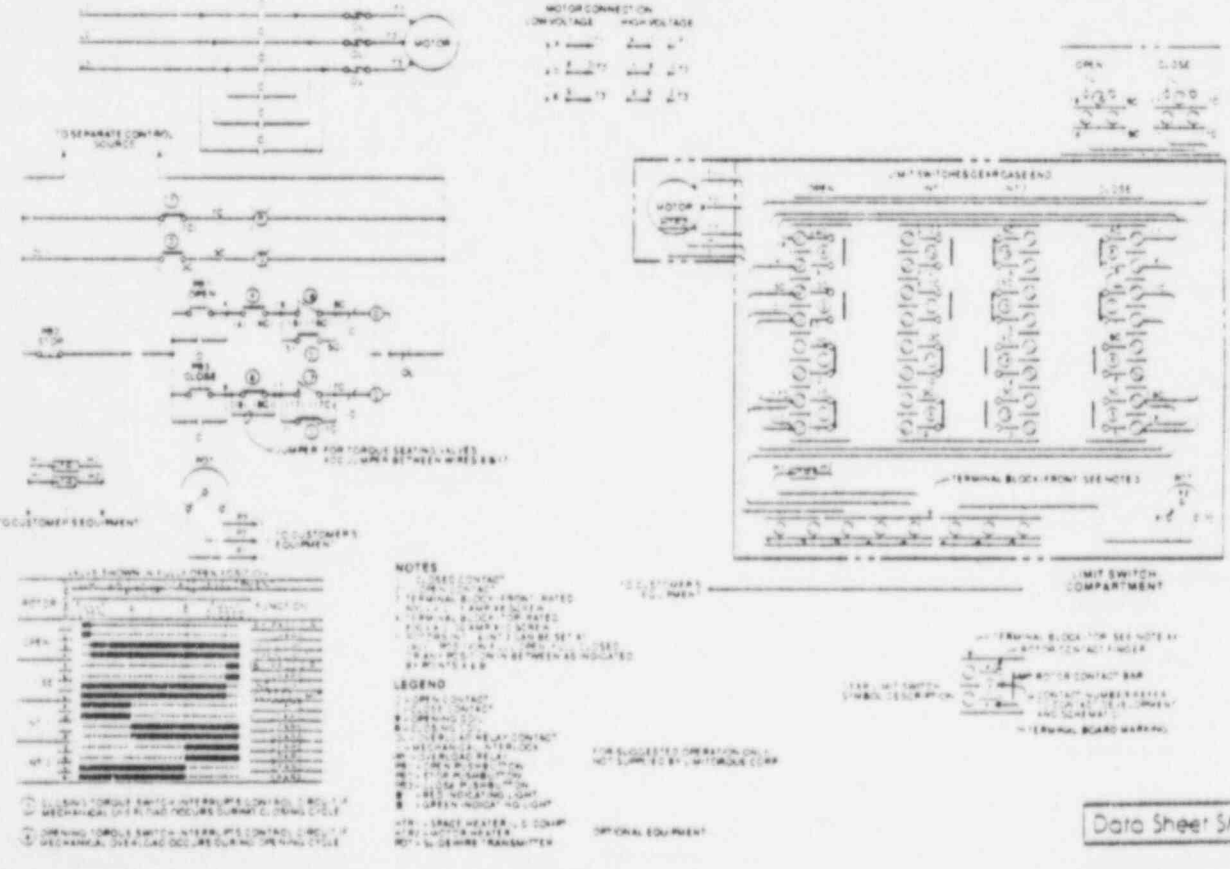
WIRING DIAGRAMS

BASIC UNIT 4 ROTOR/2 CONTACT SWITCH



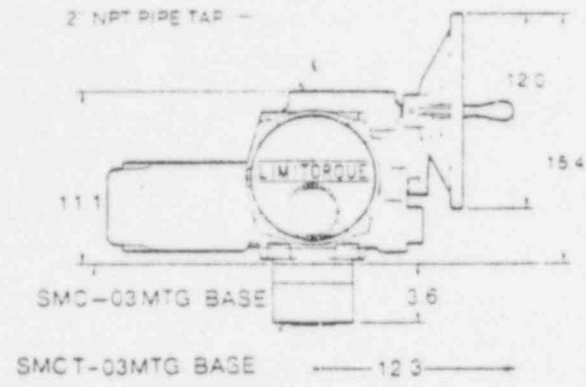
Data Sheet SMC-200

BASIC UNIT 4 ROTOR/4 CONTACT SWITCH



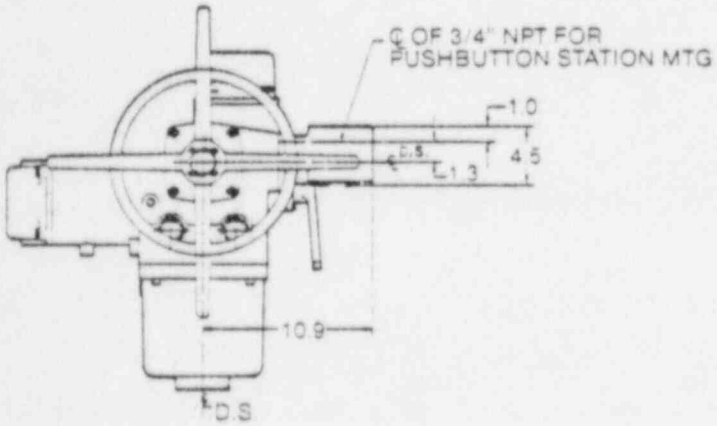
Data Sheet SMC-201

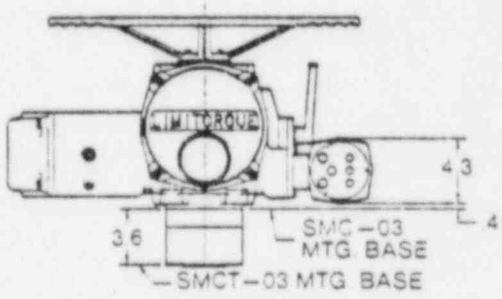
SMC/SMCT-03 WITH SIDE MOUNTED HANDWHEEL



Data Sheet SMC-110

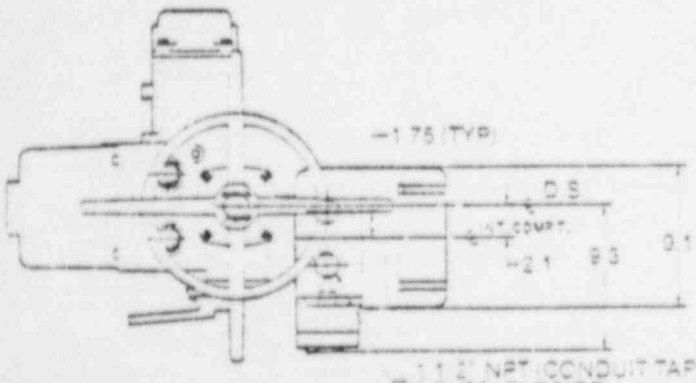
SMC/SMCT-03 WITH SW PUSHBUTTON STATION

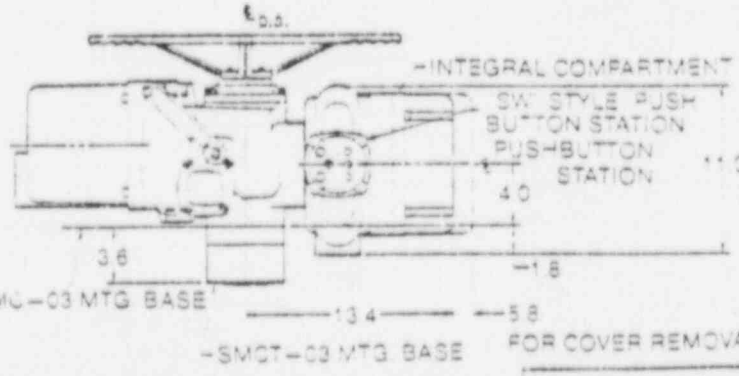




Data Sheet SMC-111

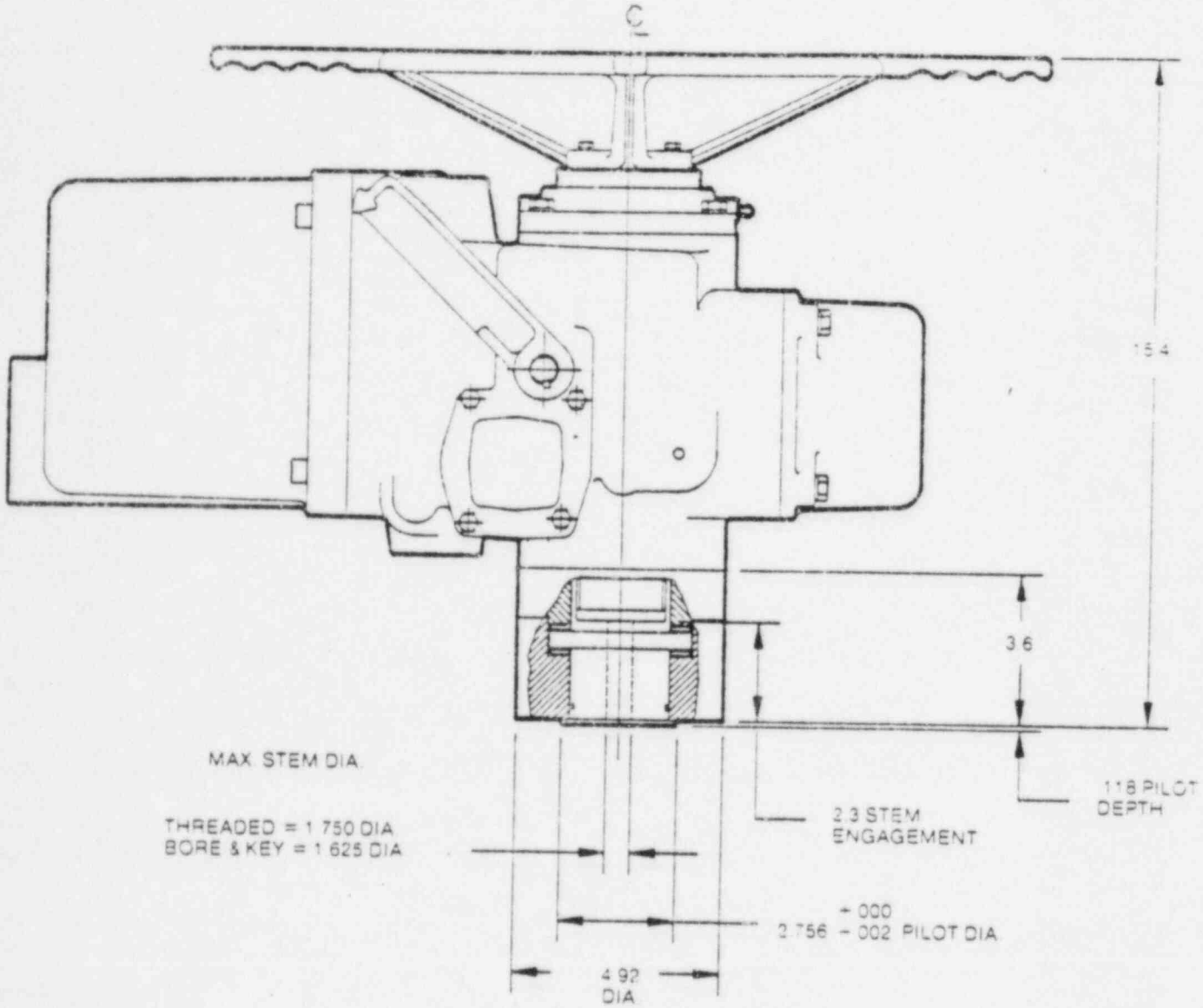
SMC/SMCT-03 WITH INTEGRAL CONTROLS AND SW PUSHBUTTON STATION

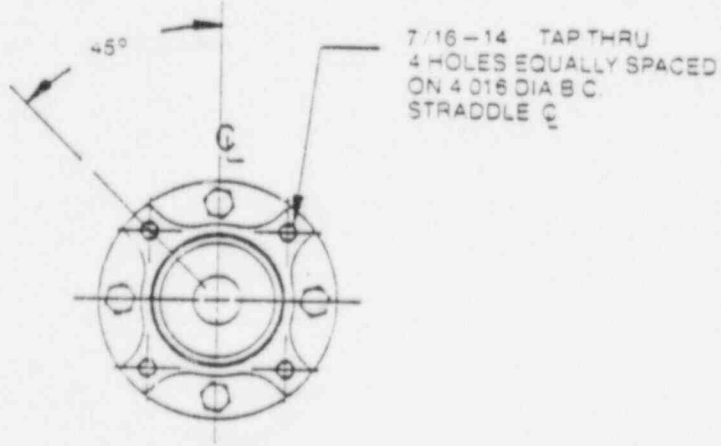




Data Sheet SMC-112

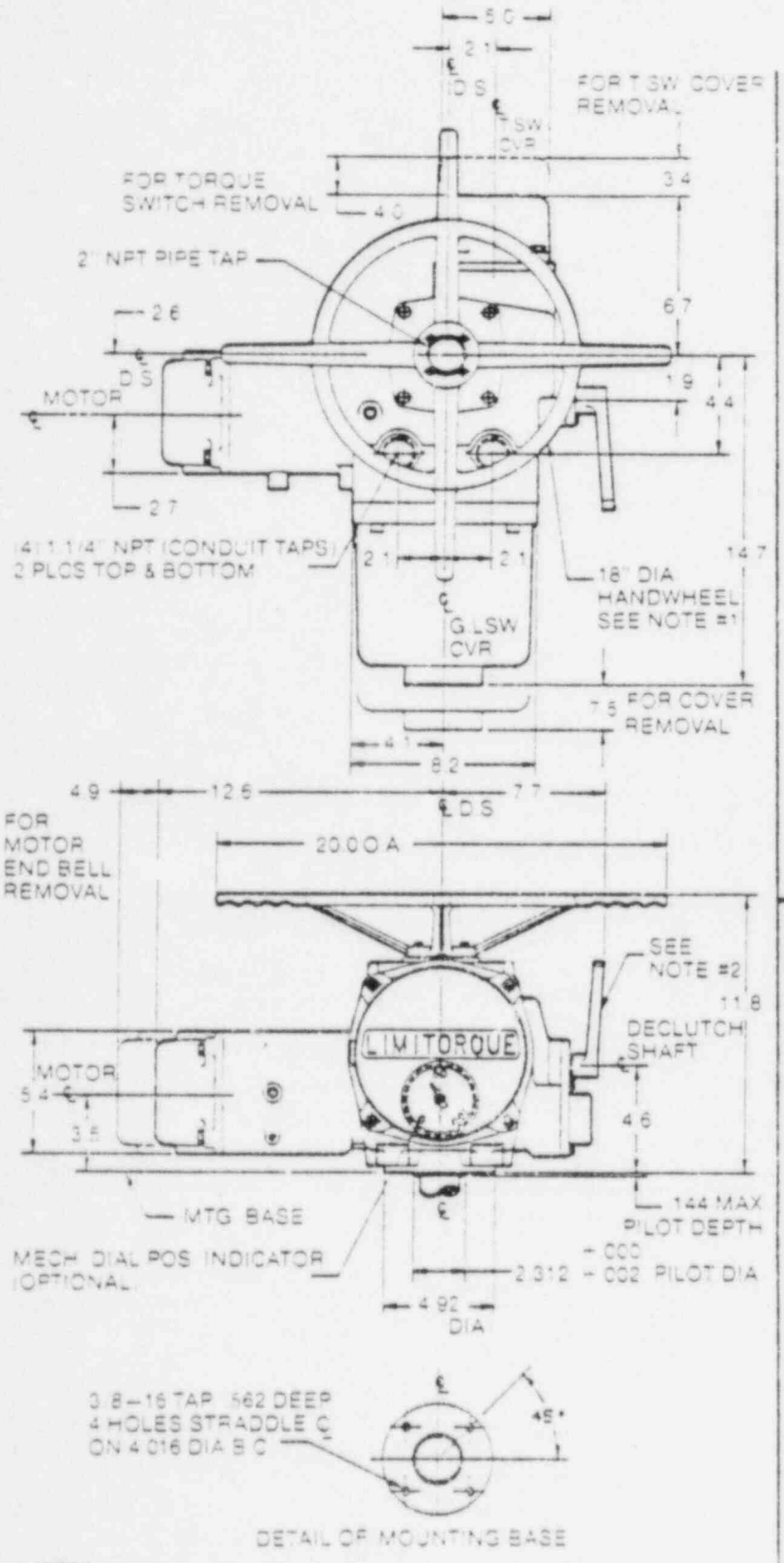
SMCT-03 BASIC ACTUATOR



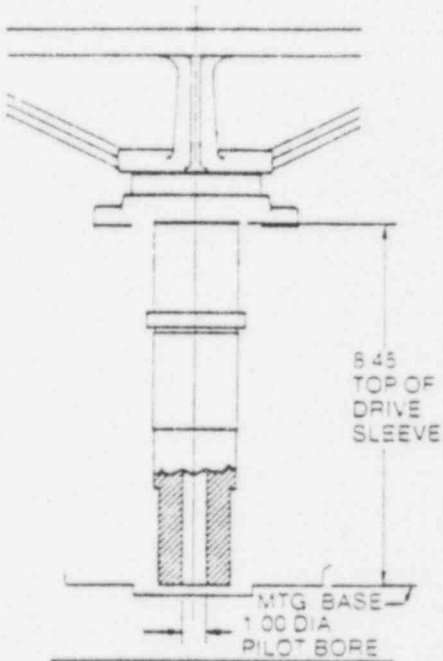


DETAIL OF THRUST BASE MOUNTING FACE

SMC-03 BASIC ACTUATOR



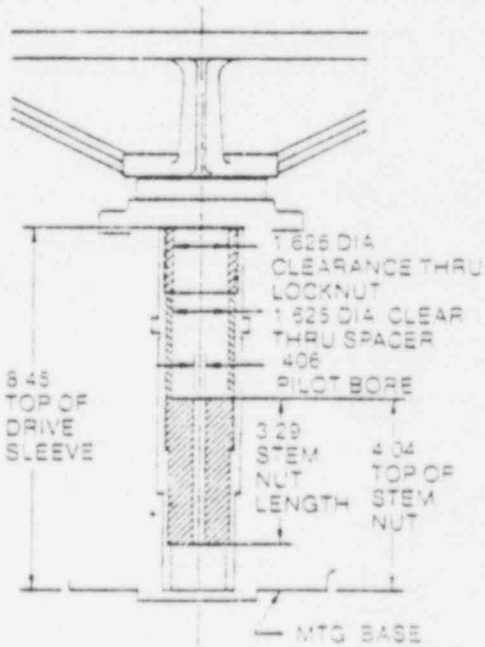
NOTES
1. HANDWHEEL ROTATION CLOCKWISE TO CLOCKWISE DRIVE SLEEVE OUTPUT LOOKING DOWN ON TOP OF ACTUATOR.
2. MANUAL OPERATION. PUSH IN DIRECTION OF ARROW ONLY. UNIT REMAINS IN HAND OPERATION UNTIL MOTOR IS ENERGIZED.



MAX BORE	MAX KEYWAY
1.50 IN. DIA	3/8 x 3/16
1.625 IN. DIA	3/8 x 1/8

1 PC DRIVE SLEEVE

Data Sheet SMC-10B

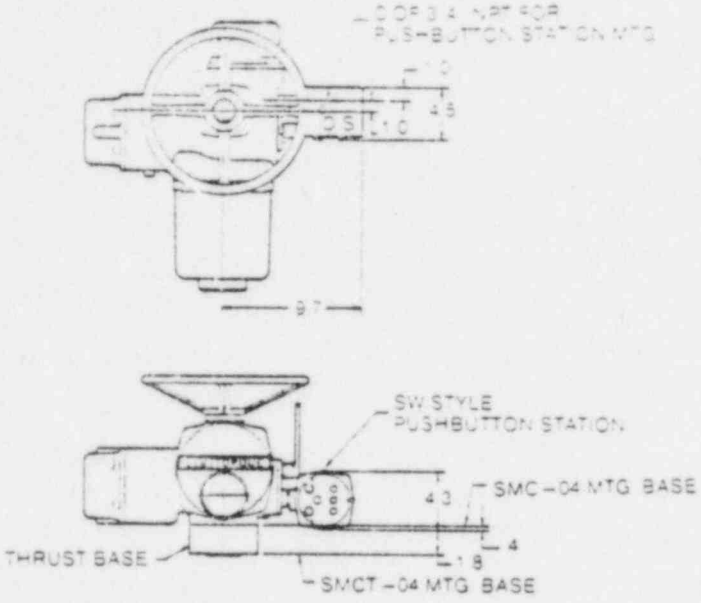


MAX BORE & KEYWAY	1.375 IN. DIA 3/8 x 1/8
THREADED 1.50 IN. DIA MAX	

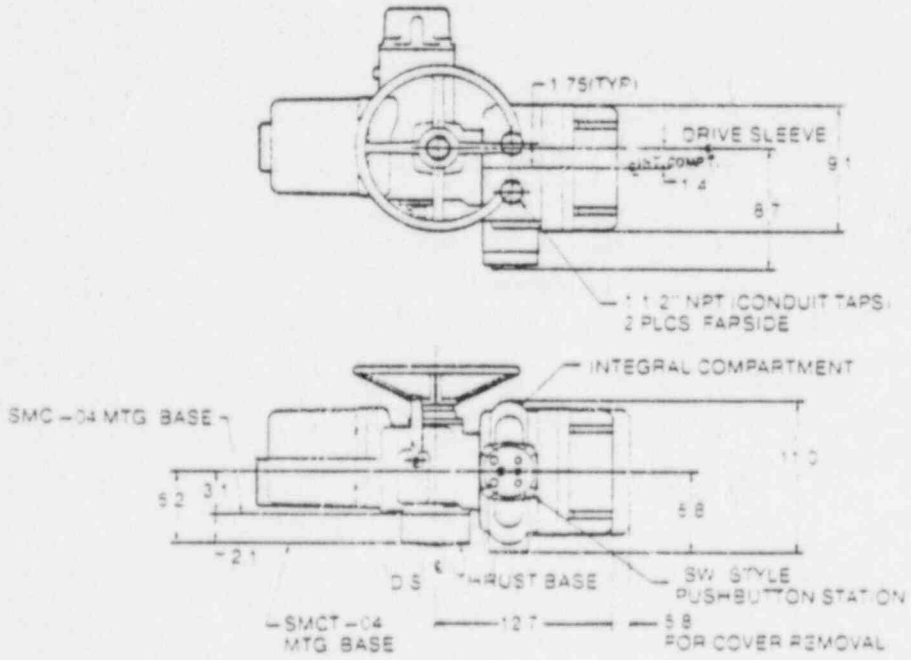
2 PC – NUT

Data Sheet SMC-10C

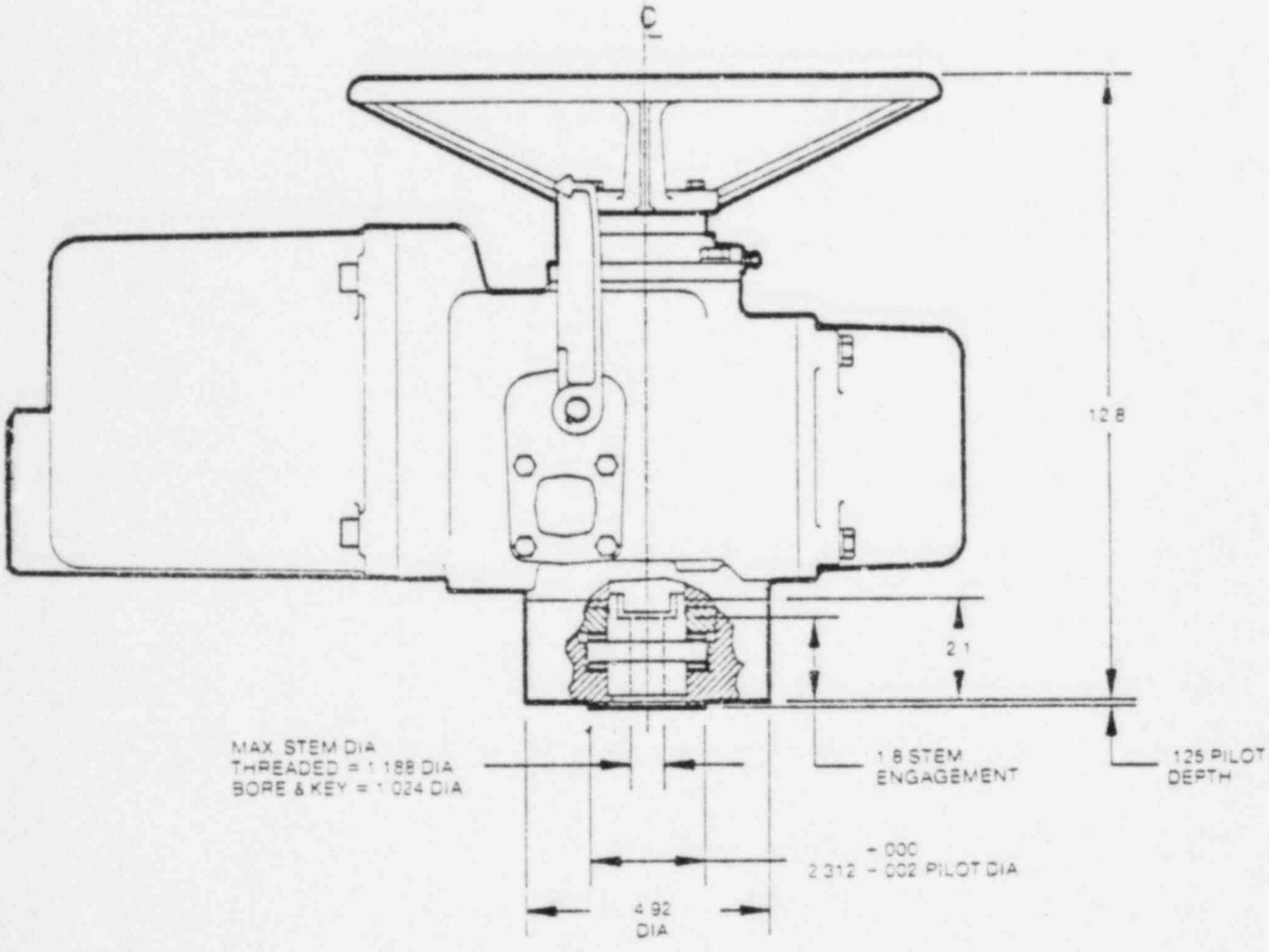
SMC/SMCT-04 WITH SW PUSHBUTTON STATION

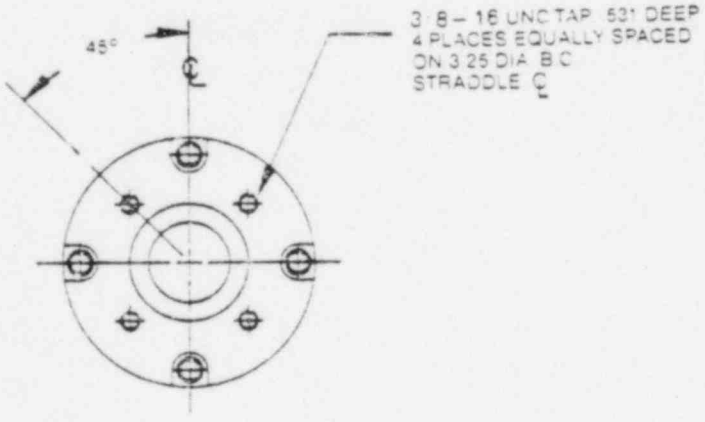


SMC/SMCT-04 WITH INTEGRAL CONTROLS AND SW PUSHBUTTON STATION



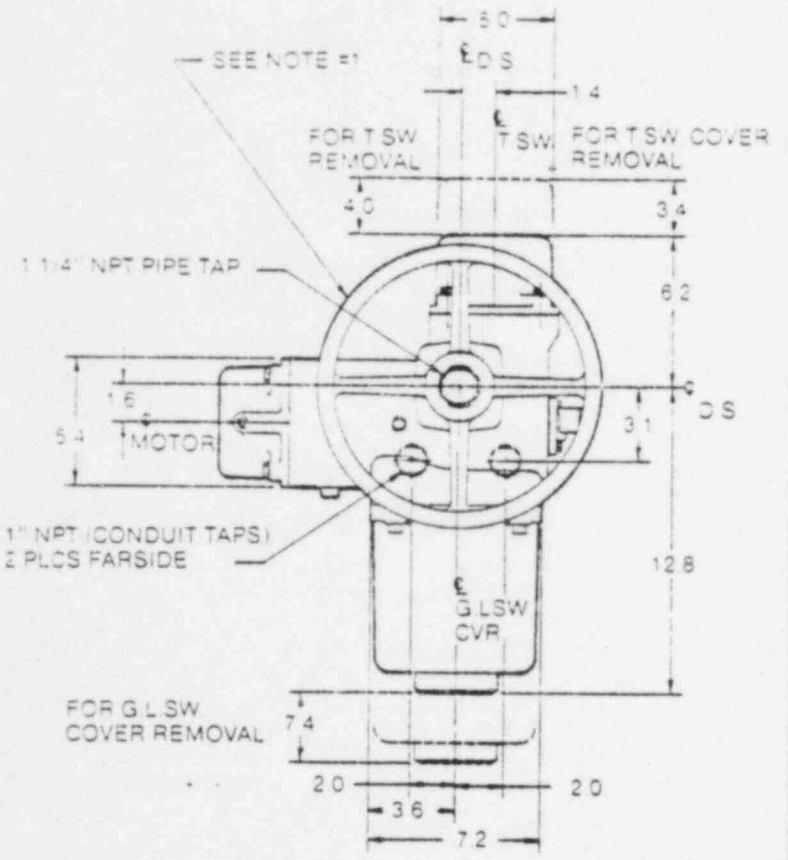
SMCT-04 BASIC ACTUATOR

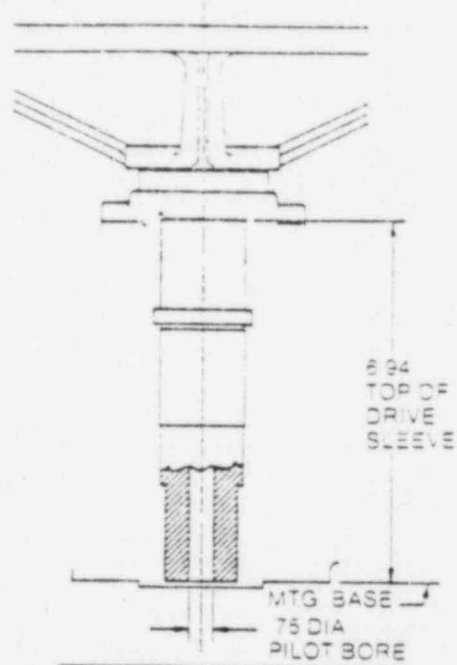




DETAIL OF THRUST BASE MOUNTING FACE

SMC-04 BASIC ACTUATOR

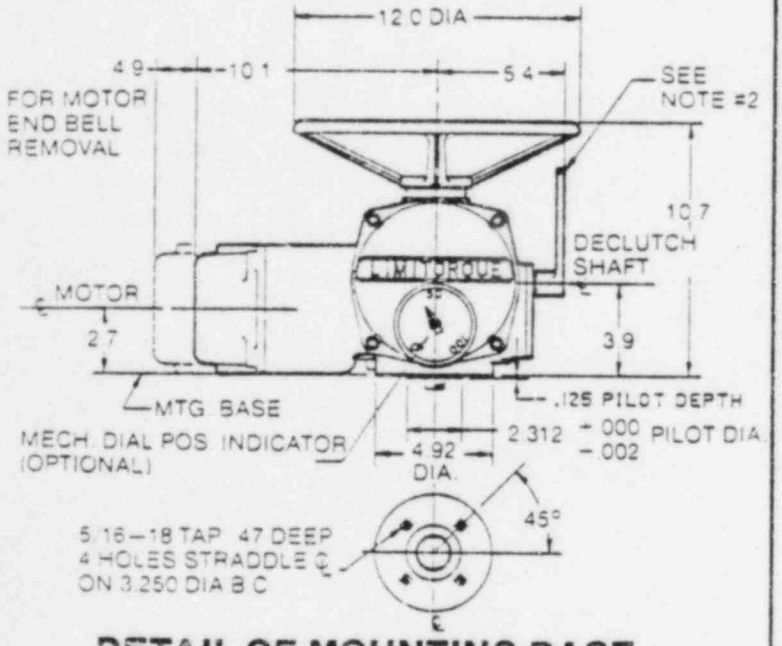




MAX BORE	MAX KEYWAY
1.00 IN. DIA	1/4 x 1/8
1.125 IN. DIA	3.16 x 3.32

1 PC DRIVE SLEEVE

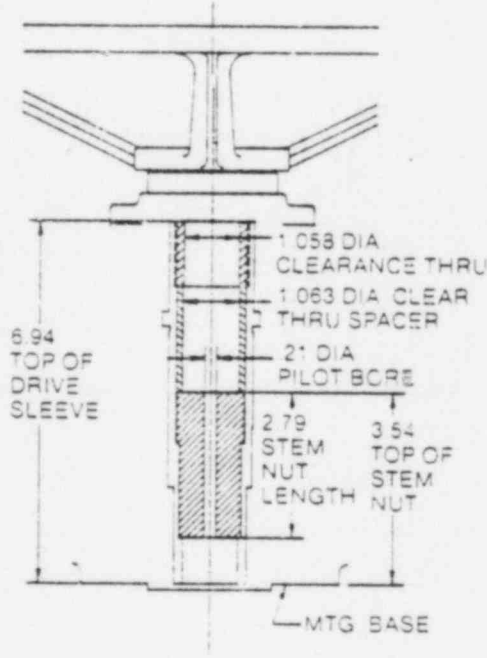
Data Sheet SMC-102



DETAIL OF MOUNTING BASE

NOTES
1. HANDWHEEL ROTATION CLOCKWISE TO CLOCKWISE DRIVE SLEEVE OUTPUT LOOKING DOWN ON TOP OF ACTUATOR
2. DECLUTCH LEVER: MANUAL OPERATION. PUSH IN DIRECTION OF ARROW ONLY. UNIT REMAINS IN HAND OPERATION UNTIL MOTOR IS ENERGIZED

Data Sheet SMC-100



MAX BORE & KEYWAY	.875 IN. DIA BORE 3.16 x 3.32 KEYWAY
THREADED	1.00 IN. DIA. MAX.

2 PC–NUT

Data Sheet SMC-101

SMC/SMCT-04 & 03 SERIES
STANDARD DRAWING LIST

Description:	Data Sheet No.:
SMC-04 BASIC ACTUATOR	SMC-100
SMC-04 2 PC STEM NUT	SMC-101
SMC-04 1 PC DRIVE SLEEVE	SMC-102
SMCT-04 BASIC ACTUATOR	SMC-103
SMC/SMCT-04 WITH SW PUSHBUTTON STATION	SMC-104
SMC/SMCT-04 WITH INTEGRAL CONTROLS AND SW STATION	SMC-105
SMC-03 BASIC ACTUATOR	SMC-106
SMC-03 2 PC STEM NUT	SMC-107
SMC-03 1 PC DRIVE SLEEVE	SMC-108
SMCT-03 BASIC ACTUATOR	SMC-109
SMC/SMCT-03 WITH SIDE MOUNTED HANDWHEEL	SMC-110
SMC/SMCT-03 WITH SW PUSHBUTTON STATION	SMC-111
SMC/SMCT-03 WITH INTEGRAL CONTROL AND SW STATION	SMC-113

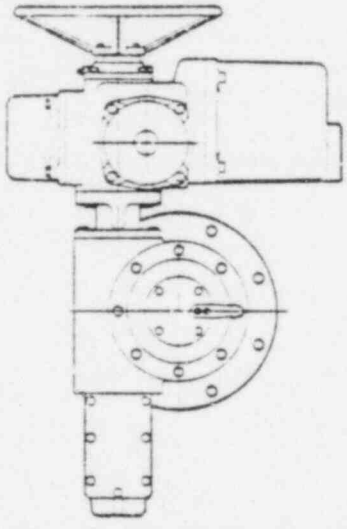
WIRING DIAGRAMS

BASIC UNIT – 4 ROTOR/2 CONTACT	SMC-200
BASIC UNIT – 4 ROTOR/4 CONTACT	SMC-201
UNIT WITH SW STATION – 4 ROTOR/2 CONTACT	SMC-202
UNIT WITH SW STATION – 4 ROTOR/4 CONTACT	SMC-203
UNIT WITH INTEGRAL CONTROLS AND SW STATION – 4 ROTOR/2 CONTACT	SMC-204
UNIT WITH INTEGRAL CONTROLS AND SW STATION – 4 ROTOR/4 CONTACT	SMC-205

OPTIONAL EQUIPMENT

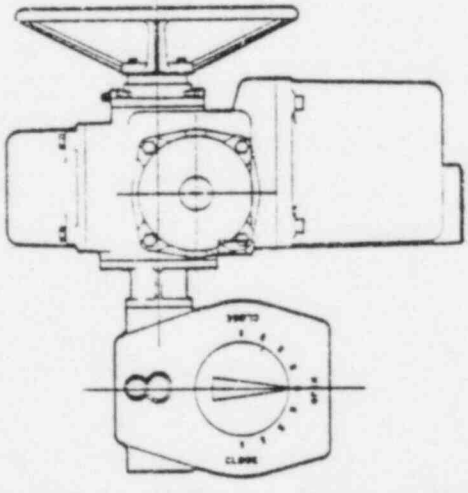
COMBINATION UNITS

SMC UNITS WITH HBC ACTUATORS



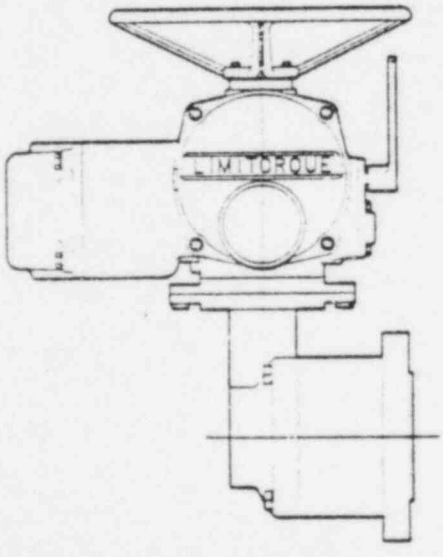
This combination is principally provided for the purpose of providing 90° output rotation, with torque outputs exceeding 13,000 ft-lbs. The HBC Series is equipped with a splined adapter for ease of mounting. (See Bulletin HBC-81)

SMC UNITS WITH VGCC/VGC ACTUATORS



This is the most economical combination for providing 90° output rotation for torque outputs up to 2920 ft-lb. The drive sleeves of the VGC/VGCC units are bored and keyed to valve shaft acceptance. (See Bulletin VGCC-80)

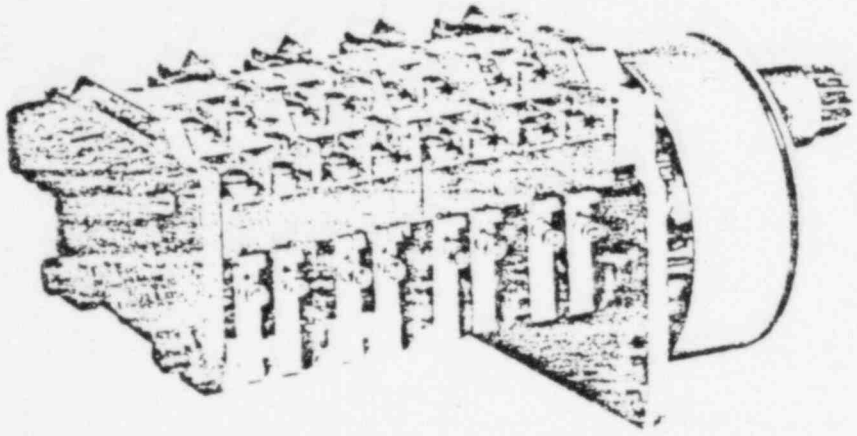
SMC UNITS WITH VBT ACTUATORS



This combination is principally designed for rising stem applications and is capable of handling thrust loads up to 80,000 lbs. output torque values to 530 ft-lbs and stem diameters of 2-5/8 inches. (See Bulletin VB-80.)

OPTIONAL EQUIPMENT

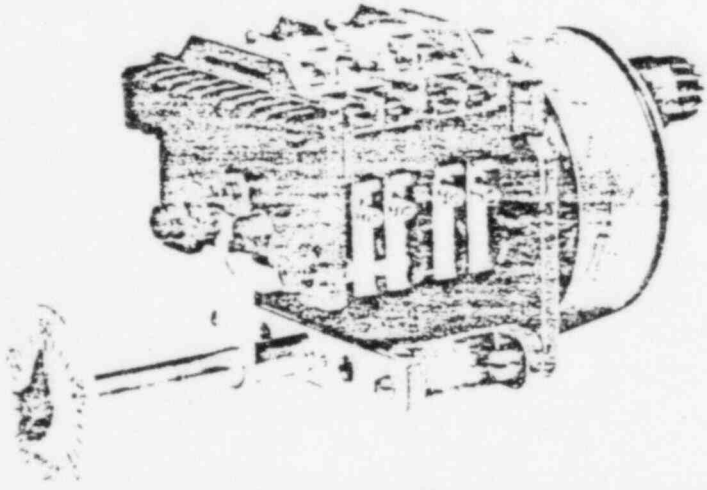
GEARED POSITION LIMIT SWITCH
4 ROTOR/4 CONTACTS EACH ROTOR



Incorporates all the features of the standard 4 rotor—2 contact switch previously described, but consists of 4 contacts per rotor. Each contact can be arranged as N.O. or N.C., depending upon customer requirements.

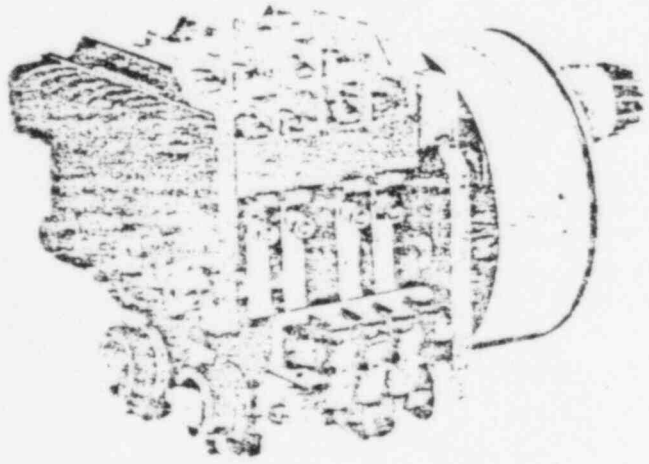
Due to simplicity of construction of rotor design, field changes can be readily accomplished from 2 contacts per rotor to 4 contacts per rotor, if subsequent operational conditions make this necessary.

LOCAL POSITION INDICATION



1. Provides continuous indication of valve position, and in common with the limit switch, is positively driven from the actuator drive sleeve.
2. The indicator dial rotates through 270° and is viewed through a window in the limit switch cover.
3. Standard scale markings are 0 to 100%.

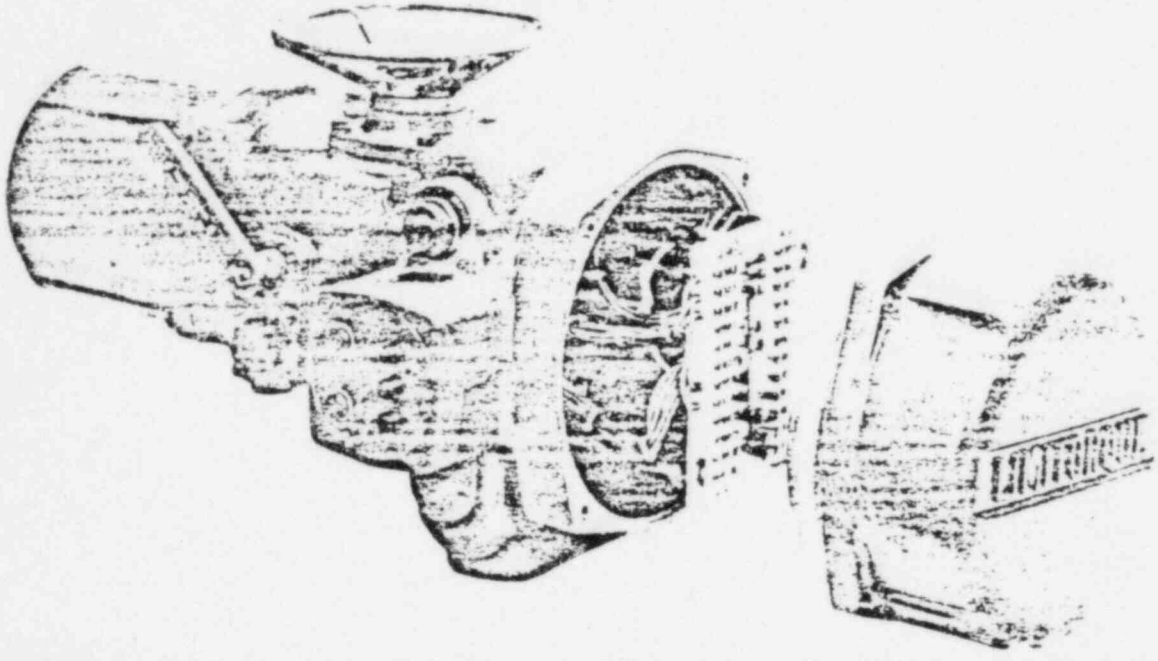
REMOTE POSITION INDICATION



1. Provides a means of transmitting the valve position to a location remote from the actuator.
2. A potentiometer or a pair is incorporated in the local position indicator assembly and is driven directly from the local indicator shaft.
3. Normal rating of the potentiometer is 50 ohms/2.5 watts, but other values can be furnished.

STANDARD EQUIPMENT

INTEGRAL CONTROL PACKAGE

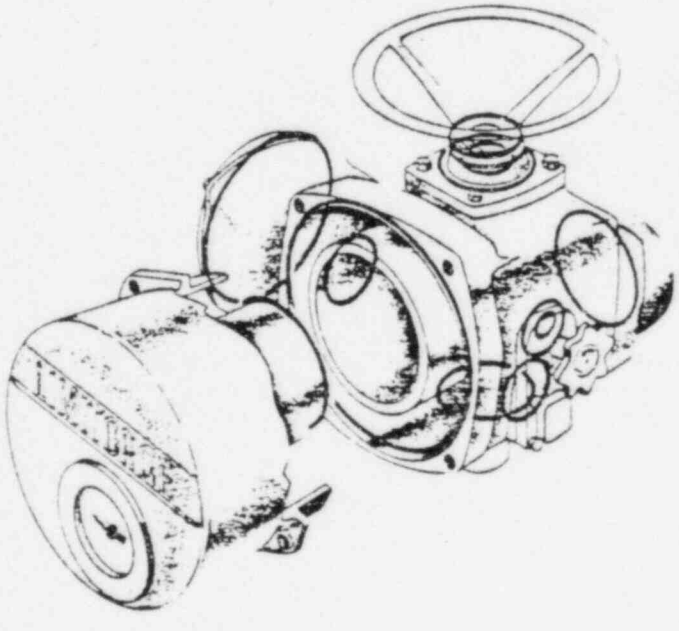


The SMC/SMCT-04 & 03 Series is available with a standardized modular integral control package. The standard assembly includes an integral reversing controller (mechanically interlocked), automatic reset overload relay for each phase of the power supply, 120 volt/20 watt space heater, 75VA transformer with fused secondary (460/230 to 120 volt) and a 24 point terminal strip.

In addition, modular local control packages are available, consisting of push-buttons, indicating lights and selector switches if required.

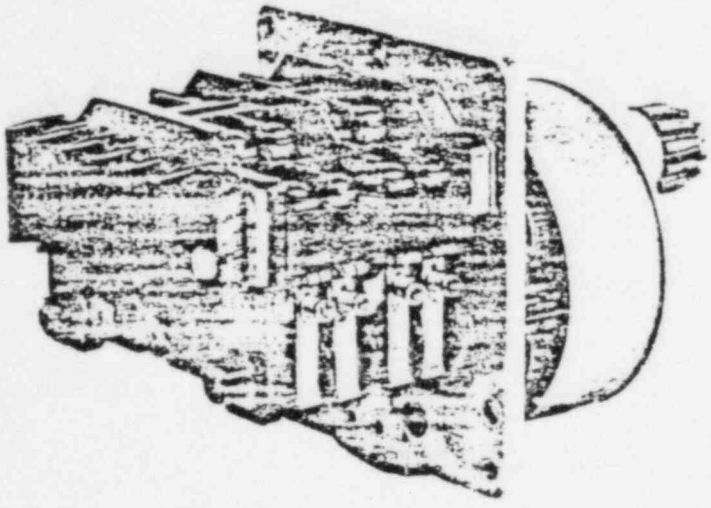
COMPLETE SEALING

All units completely sealed with large cross section o-rings and/or quad-rings in order to maintain maximum integrity of compartments.



STANDARD EQUIPMENT

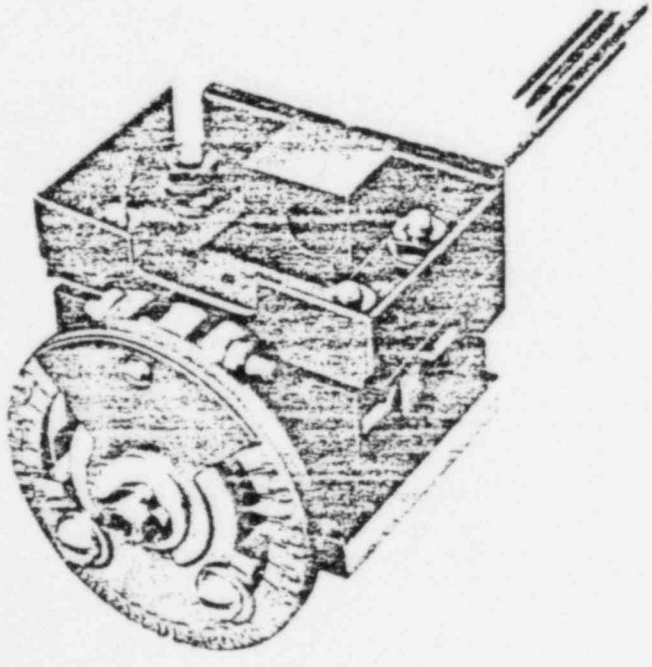
GEARED POSITION LIMIT SWITCH
4 ROTOR/2 CONTACT EACH ROTOR



Features

1. Direct driven from the actuator drive sleeve.
2. Intermittent gear drive—infinitely adjustable—no damage should overtravel occur—all metallic.
3. Four independently adjustable operating positions, each with two contacts per position. Each contact can be arranged as N.O. or N.C., depending upon customer requirements.
4. All contacts are made of heavy inlaid silver.

DOUBLE TORQUE SWITCH



Features

1. Ensures tight shut-off on valves requiring torque seating.
2. Provides complete valve/actuator protection for both directions of travel.
3. Heavy-duty inlaid silver contacts are readily visible.
4. Large scale dial and single locking screw for ease of setting.
5. Infinitely adjustable over torque range of actuator.
6. Equipped with torque limiter plate to prevent unauthorized setting beyond limits of valve or actuator.

TECHNICAL DETAILS

NOTES:

1. All output speeds shown are approximate and may vary ±8%. Speeds are based on 60 hertz service 3 phase power supply.
2. To obtain speeds for 50 hertz 3 phase power supply multiply chart speed by 0.85.
3. If exact output speed is required consult factory.
4. All ratios calibrated for above non-locking gear ratios.

SMC SERIES-SPEED/TORQUE SELECTION CHARTS (COMMERCIAL RATINGS)

Unit Type & Size	Motor Size (Ft-Lb)	Motor Speed (RPM)	OUTPUT SPEED (RPM)												
			12	18	24	30	36	42	48	54	60	72	84	96	108
			OUTPUT TORQUE (FT-LB)												
SMC-04 & SMCT-04	3	1200	70												
	3	1800		50	57	44	42	37	35	29	26	23		18	
	5			80	80	70	70	62	58	48	43	38		30	
	7.5					80	80	80	80	72	65	58		45	
	5	3600								80	74	70	64	58	48
SMC-03 & SMCT-03	7.5	1800	187	138	156	127	104	95	78	71	88	72	65	54	49
	10		200	184	200	169	139	127	104	95	117	96	87	72	65
	15			200		200	200	190	156	142	176	144	130	108	98
	25							200	200	200	200	200	200	180	163
	10	3600									170	139	115	104	94
	15										200	200	173	156	141

TECHNICAL DETAILS

NOTES:

1. Motor availability based on 3 phase 60 cycle and 3 phase 50 cycle motors. Optional single phase motors are also available.
   5 ft-lb 1800 on 04 units
   10 ft-lb 1600 on 03 units
2. Ratio range blocks colored tan are non-locking gear sets
3. Standard voltages are
   230/460 220/440 208/416 and 575 volts 60 hertz
   190/380 volts 50 hertz
4. Standard units are suitable for submersion in a 20 foot maximum head of water for 24 hours
5. All units are supplied with dirt drive handwheels. An optional side mounted handwheel drive (3:1 ratio) available on SMC/SMCT-03 units

SMC SERIES (COMMERCIAL RATINGS)

Unit Type & Size	Maximum Torque		Maximum Thrust Capacity (Lbs)	Maximum Stem Capacity (Inch)				Motor Availability (Nominal Size-Ft-Lb)		
				2 Pc Nut Design		1 Pc Nut Design				
	Ratio Range	Torque (Ft-Lb)		Threaded	Bore/Keyed	Threaded	Bore/Keyed	1200 RPM	1800 RPM	3600 RPM
SMC-04	18.5-39.5	80	8000	1	7/8 3/16x3/32	N/A	1 1/8 3/16x1/16	3	3	
	46.0-67.3								5	5
	70.3-90.6								7.5	
SMCT-04	18.5-39.5	80	12000	N/A	N/A	1 3/16	1 1/8 1/4x1/8	3	3	
	46.0-67.3								5	5
	70.3-90.6								7.5	
SMC-03	15.7-28.2	200	12000	1 1/2	1 3/8 5/16x1/8	N/A	1 5/8 3/8x1/8		7.5	1
	31.7-70.2								10	10
	72.4-131.7								15	15
									25	
SMCT-03	15.7-28.2	200	20000	N/A	N/A	1 3/4	1 5/8 3/8x3/16		7.5	
	31.7-70.2								10	10
	72.4-131.7								15	15
									25	

N/A Not Available

SMC/SMCT-04 & 03 SERIES
ELECTRIC VALVE ACTUATORS

Applications

The SMC/SMCT-04 & 03 series actuators represent the latest "state-of-the-art" in valve actuation and have been designed for any valve mechanism requiring rotary torque or linear thrust.

For direct mounted applications, uses are: gate valves, globe valves, sluice gates, penstocks or for any rising or non-rising stem application.

When coupled with either Limitorque VGCC/VGC or HBC quarter turn units, the combination can be used on: butterfly valves, ball valves, plug valves, damper drives, flap gates or simply devices requiring 90° movement.

These actuators have been used successfully in all industries, such as: Water and Sewage Treatment Works, Power Plants (Conventional and Nuclear), Petrochemical Facilities, Marine Applications, Chemical Processing and Power Transmission areas.

Types of Units

The **SMC** Series incorporates the patented top entry stem nut which has been Limitorque's standard for over 50 years. This concept permits ease of stem nut replacement without the necessity for actuator removal from the valve.

The **SMCT** Series utilizes an add-on thrust base attachment which provides acceptance of larger stem diameters and larger thrust capacities than the SMC Series. This design permits removal of the actuator from the valve while under pressure, should general service of the actuator be required.

General Description

All components used in both series are made from the highest quality materials in order to ensure maximum reliability. All units are suitable for outdoor service, are weatherproof and are factory grease lubricated. With minor modifications all units can be supplied as submersible or explosion proof.

Construction

1. All castings are produced from high aluminum alloys in order to provide maximum strength with low weight. (Units can be supplied with grey iron castings as an option.)
2. A high strength bronze worm gear and tabourized hardened worm combine to provide extra long life, tested over 30,000 full rated cycles.
3. Completely reliable double torque switch which utilizes heavy duty silver tip open contacts. The switch is adjustable over the entire torque range of the unit and is designed for protection in both directions of travel.
4. A four position geared limit switch is standard for all units and is equipped with a "modular" rotor which can be assembled in any arrangement of N.O. and N.C. contacts to suit individual requirements. Standard is two contacts per rotor with an option of four per rotor. The switch is furnished with an intermittent gear train (all metallic) allowing infinite adjustability over the entire range of travel.
5. All compartment enclosures are sealed by large cross section o-rings in order to provide optimum compartment integrity.
6. A declutch lever operated mechanism is standard on all units, which permits engagement of handwheel operation. When the motor is energized, the unit automatically returns to motor operation without imparting any motion to the handwheel, thereby ensuring personnel safety.
7. All shafts, gears and other rotating components are supported on heavy duty anti-friction bearings, to provide the highest possible efficiency.
8. All units are supplied with motor grounding lugs as standard.

Types of Enclosures

1. Weatherproof — Fully conform to Nema I, III, IV and VI specifications.
2. Explosion-proof.

All units are certified by both Canadian Standards Association (C.S.A.) and Factory Mutual for the following services:

Class 1, Group B, Division 2
Class 1, Group C & D, Division 1 & 2

Units are also certified by BASEEFA (Cenelec) for the following services:

Groups 11a and 11bT4 (BS 5501 Part 5)

Motors

Units are normally supplied with 3 phase motors, but alternative single phase, direct current, pneumatic and hydraulic motors are available upon request.

Optional Accessories

Many standard and special optional accessories are available with this series of actuators built-in (integrally mounted) or separate mounted reversing controllers, transformers, pushbutton stations, heaters, breathers and drains, floor stands, special motor insulation plus a wide range of electrical elements.

Quality Assurance

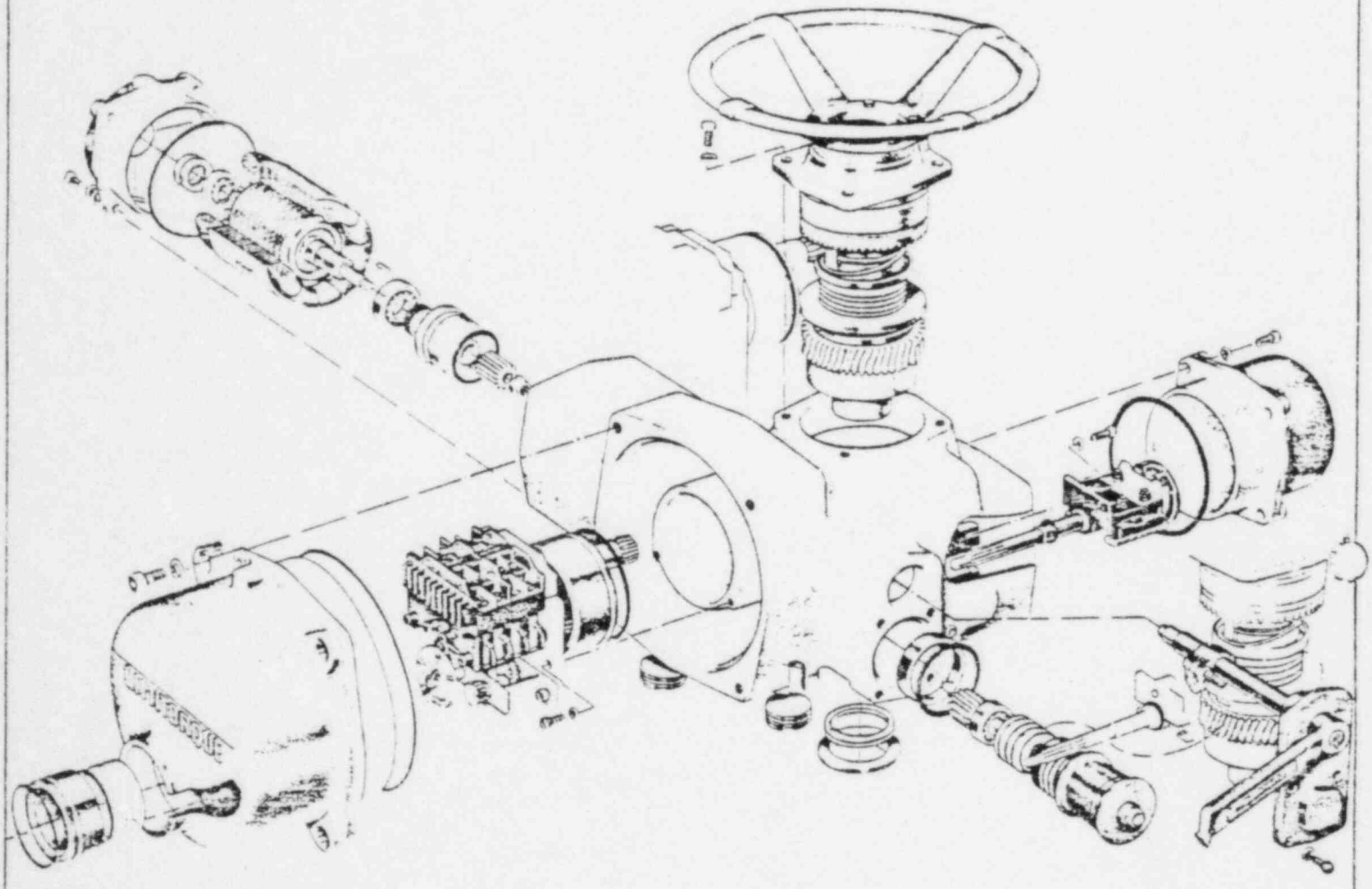
Limitorque operates a fully integrated Quality Control system to the highest Nuclear Standards throughout all its manufacturing facilities.

The company submits itself not only to regular audit by its customers but also operates a systematic internal auditing procedure.

Every phase in the production of a Limitorque actuator is meticulously monitored and great care taken to educate Limitorque personnel in detailed Quality Control practices. Not only are the actual manufacturing processes controlled but the basic design, processing of a customer's order and conformance to specification receive equally stringent attention.

In order that our customers may easily satisfy themselves as to the scope of our Quality Control procedures, Limitorque will provide a controlled copy of their Quality Assurance manual upon request. Should a more detailed appraisal be required, the Quality Control Procedures themselves are available for in house inspection.

A TYPICAL SMC ACTUATOR

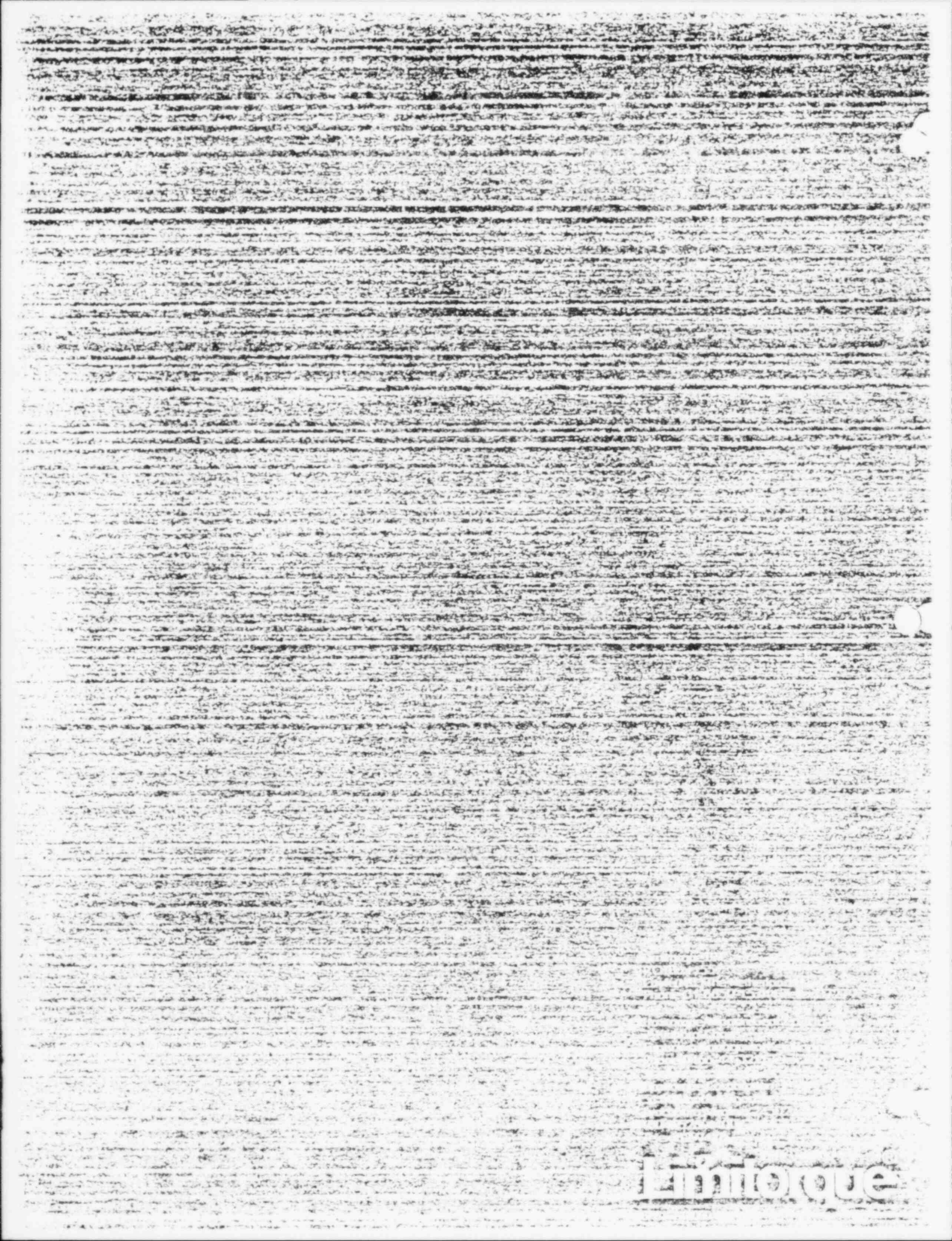


LIMITORQUE

SMC/SMCE04 & 08 SERIES

ELECTRIC VALVE ACTUATORS

A PRODUCT OF LIMITORQUE® CORPORATION



ELECTRICAL COMPONENTS

Position Indicators: Local:

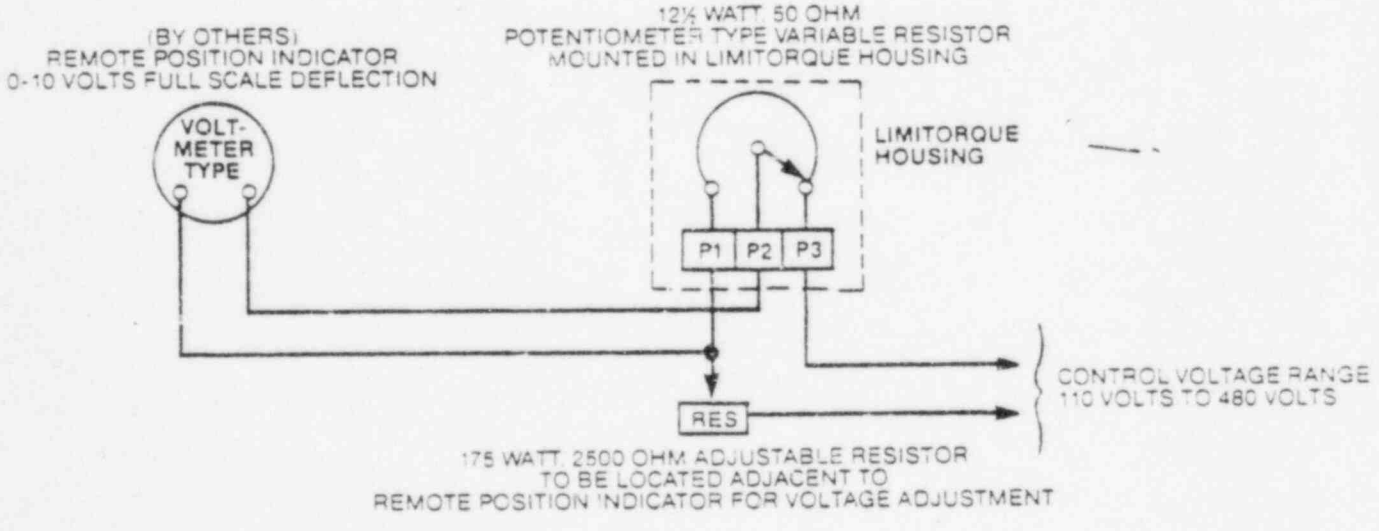
1. The local position indicator is factory selected to show valve position but can only be adjusted when mounted on the valve.
2. Disconnect all incoming power and remove Limit Switch Compartment Cover #85.
3. Place valve in the fully closed position.
4. Loosen the round head machine screw which holds the pointer in place, move the pointer to the "O" position, and re-tighten the screw. The indicator is now set.

NOTE: For assemblies supplied for remote indication, the Driving Pinion has been shipped loose in a bag, to protect the potentiometer from being damaged by accidental rotation of the handwheel prior to installation and setting on the valve.

Remote:

CAUTION: Typical voltmeter remote indicators furnished by Limitorque are built to accept a maximum of 10 volts. It is necessary to adjust using a separate test voltmeter with a scale suitable for the maximum incoming control voltage.

1. Mount the adjustable resistor furnished as near as possible to the voltmeter indicator.
2. WITH POWER OFF, connect all wires as shown below except the two on the voltmeter indicator. Connect these two to the test meter.
3. Move the slider of the adjustable resistor to the extreme opposite end of the resistor from the power connection.
4. Disconnect all incoming power and remove Limit Switch Compartment Cover #85. Set screw in small gear which drives the transmitter (potentiometer) should already be loose. If it is not, loosen set screw so gear will not drive the transmitter.
5. Place the valve in the fully closed position. While valve is moving toward closed note which direction the small shaft and gear would be driving the wiper arm on the transmitter.
6. When valve is closed, move the wiper arm on the transmitter to the end of the transmitter coil corresponding to the close position, and tighten set screw on gear.
7. Turn power on. The test meter should now read "O" or almost "O".
8. Place the valve in the full open position.
9. Move the adjustable resistor slider toward the power connected end until the test meter reads 10 volts.
10. Turn power off, disconnect the test meter and connect leads to the voltmeter indicator.
11. Turn power on. Indicator should now read full open.
12. Final adjustment may be necessary. If the indicator reads less than full open, carefully move the adjustable resistor slider ahead being careful not to exceed the full open position on the dial. If the indicator reads more than "O" when the valve is closed, repeat the setting procedure starting with Step 6.
13. When the indicator properly shows valve position, lock the adjustable resistor slider in place.



OPTIONS

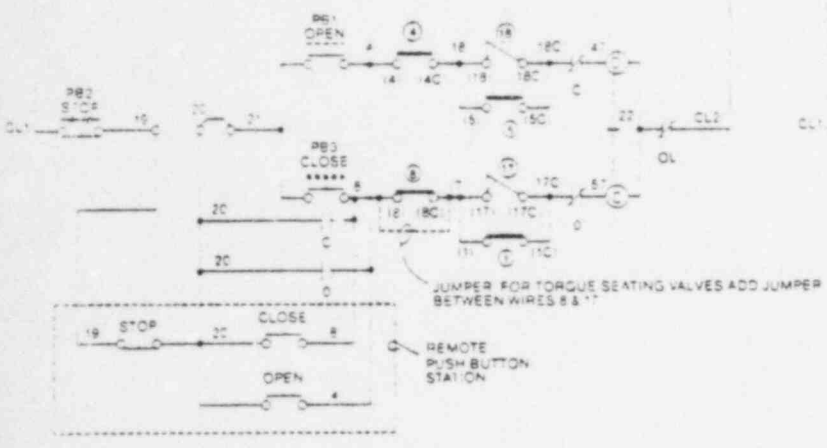
All Limitorque operators are equipped with electrical control circuits which allow the greatest flexibility possible. The standard Limitorque operator is equipped with an 8 contact geared limit switch, double torque switch (1 NC contact per direction) and an electric motor. A typical schematic is Drawing No. 15-476-4100-3 found on Page 13.

An integral reversing starter with three thermal overloads and a control transformer can be supplied as an optional extra. Built-in open/stop/close pushbuttons and two indicating lights are also available as an option and when supplied can be connected as shown on Wiring Diagram 15-476-4317-3 as typical. This drawing is found on the lower part of Page 13.

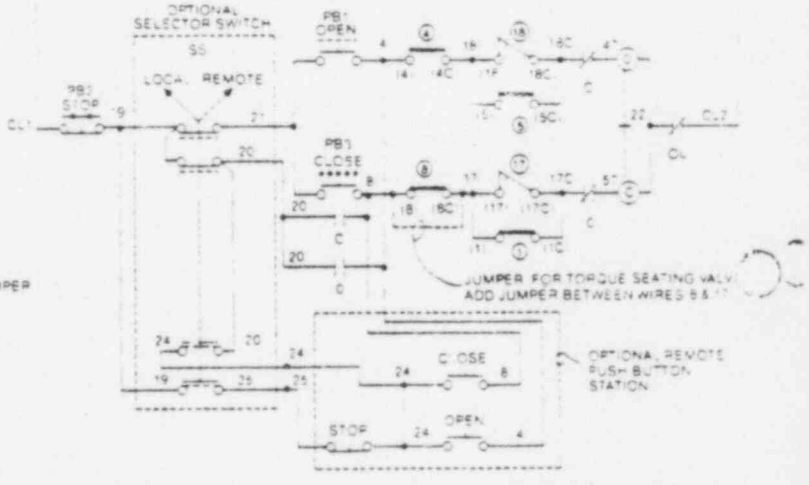
There are many variations and options available on all Limitorque equipment. Remote buttons can be wired into the electrical circuit along with the buttons supplied by Limitorque. A typical schematic showing this arrangement is found in the top view to the right.

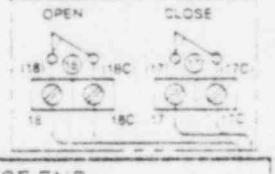
Should a customer desire to selectively choose between local and remote operation, a selector switch (2 or 3 position) can be added to accommodate this requirement. The typical schematic showing a local-remote selector switch can be seen in the center view to the right.

SUGGESTED SCHEMATIC



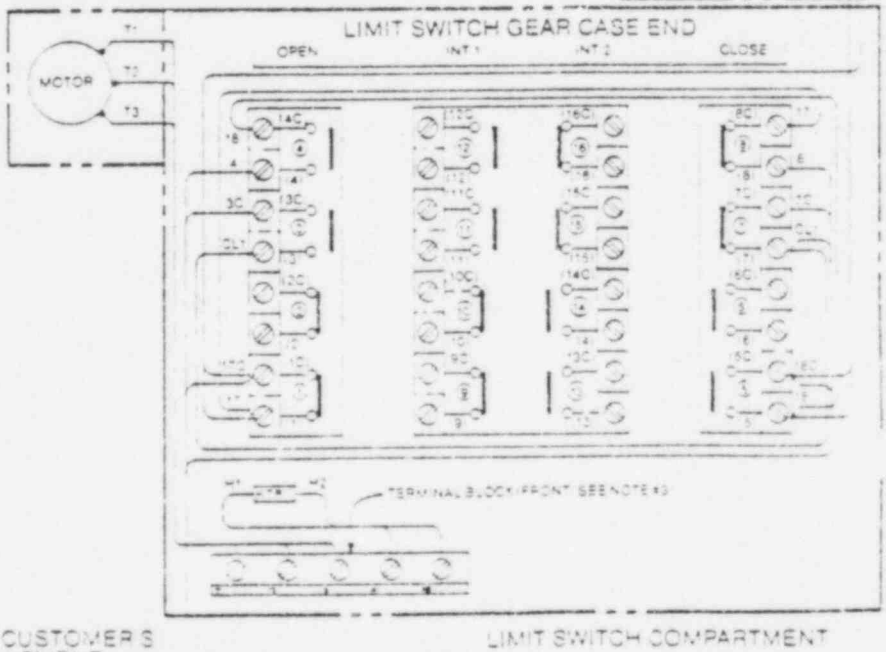
SUGGESTED SCHEMATIC



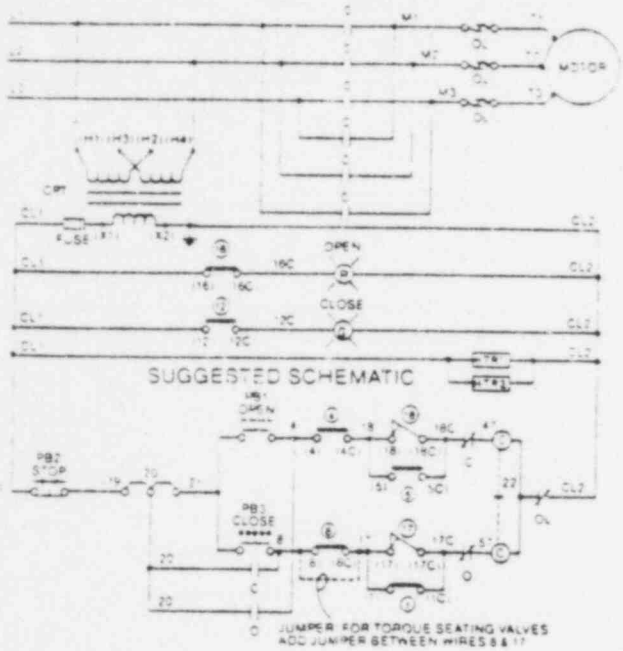


ROTOR	CONTACT	LIMIT SWITCH CONTACT DEVELOPMENT — VALVE POSITION: FULLY OPEN / A / B / FULLY CLOSED	FUNCTION
OPEN	1		BY-PASS CIR
	2		SPARE
	3		NC LIGHT
	4		OPEN LIMIT
CLOSE	5		BY-PASS CIR
	6		SPARE
	7		NC LIGHT
	8		CLOSED LIMIT
INT 1	9		SPARE
	10		SPARE
	11		SPARE
	12		SPARE
INT 2	13		SPARE
	14		SPARE
	15		SPARE
	16		SPARE

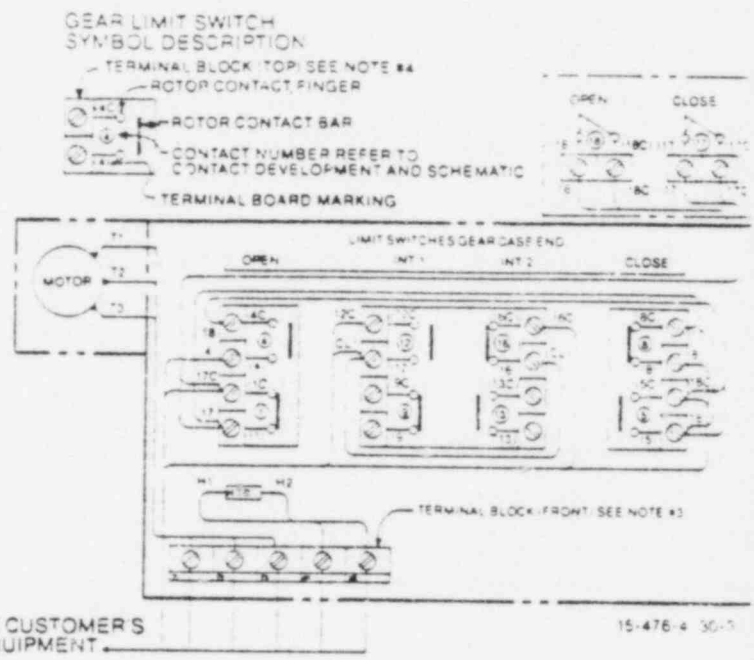
5 ROTORS INT. 1 & INT. 2 CAN BE SET AT VALVE POSITION FULL OPEN, FULL CLOSED OR ANY POSITION IN BETWEEN AS INDICATED BY POINTS A & B



TYPICAL WIRING DIAGRAM



Non-Integral Control



VALVE SHOWN IN FULLY OPEN POSITION

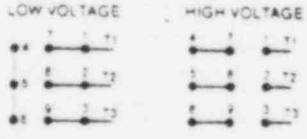
ROTOR	CONTACT	LIMIT SWITCH CONTACT DEVELOPMENT: VALVE POSITION FULLY OPEN	VALVE POSITION FULLY CLOSED	FUNCTION
OPEN	1			BY-PASS CIR
	4			OPEN LIMIT
CLOSE	5			BY-PASS CIR
	8			CLOSE LIMIT
INT 1	9			SPARE
	12			IND LIGHT
INT 2	13			SPARE
	16			IND LIGHT

(17) CLOSING TORQUE SWITCH INTERRUPTS CONTROL CIRCUIT IF MECHANICAL OVERLOAD OCCURS DURING CLOSING CYCLE

(18) OPENING TORQUE SWITCH INTERRUPTS CONTROL CIRCUIT IF MECHANICAL OVERLOAD OCCURS DURING OPENING CYCLE

O – Open Contact
C – Close Contact
(C) – Opening Coil
(C) – Closing Coil
OL – Overload Relay
OL – Overload Relay Contact
* – Mechanical Interlock
CPT – Control Power Transformer
– Red Indicating Light
– Green Indicating Light
HTR1 – Space Heater (Controls)
HTR2 – Space Heater (L.S. Compt.)
PB1 – Open Push Button
PB2 – Stop Push Button
PB3 – Close Push Button

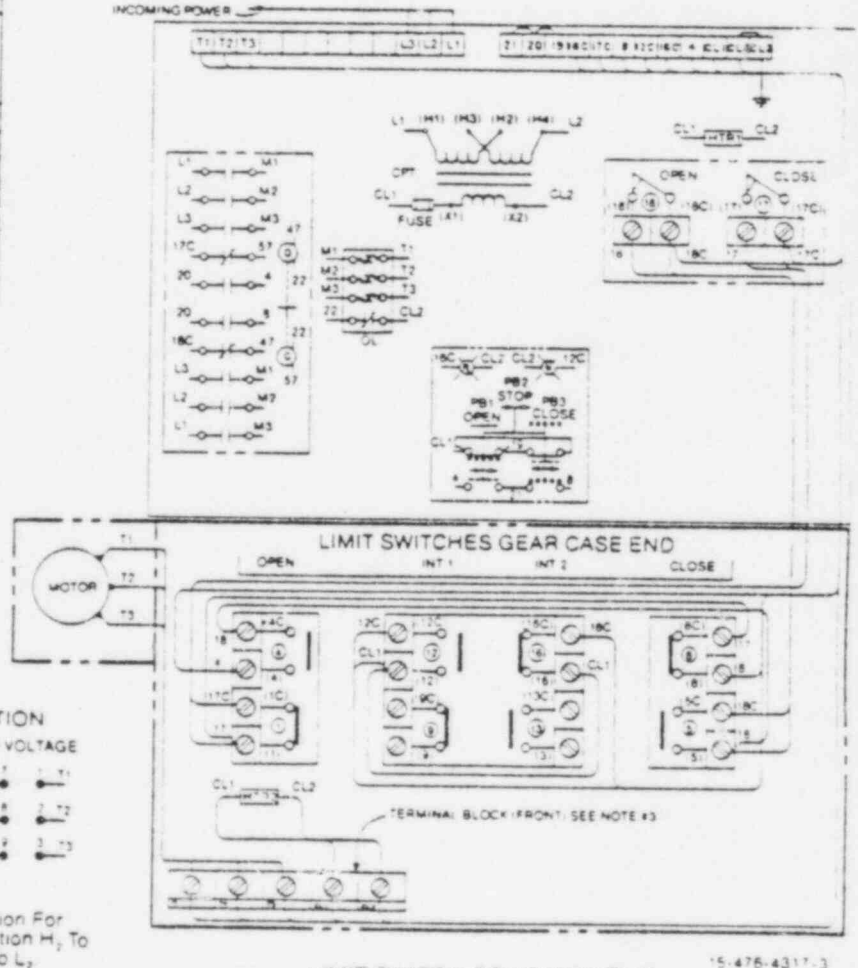
MOTOR CONNECTION



1 — Closed Contact
2 - - - Open Contact
3 Terminal Block (Front) Rated 600V AC 15 Amp #6 Screw
4 Termina. Block (Top) Rated 600V AC 30 Amp #10 Screw
5 Transformer Connection For High Voltage Connection H_1 To H_3, H_2 To L_1 and H_4 To L_2

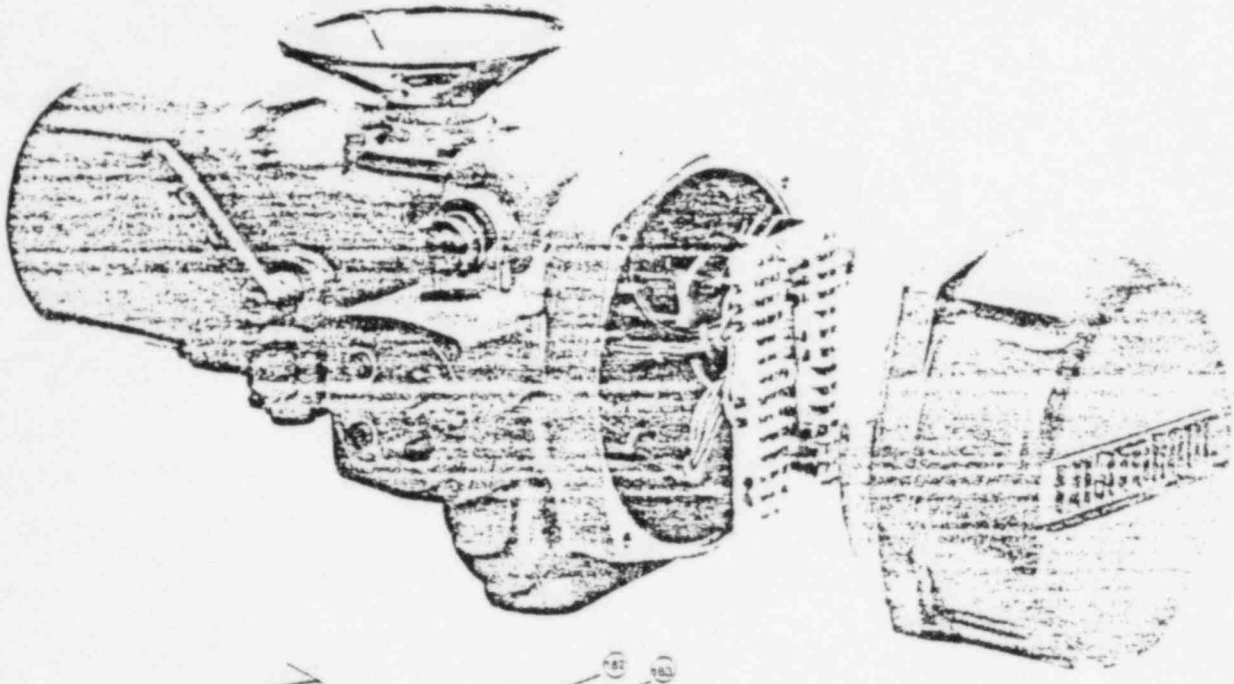
FOR LOW VOLTAGE CONNECT H_1 AND H_3 TO L_1, H_2 AND H_4 TO L_2

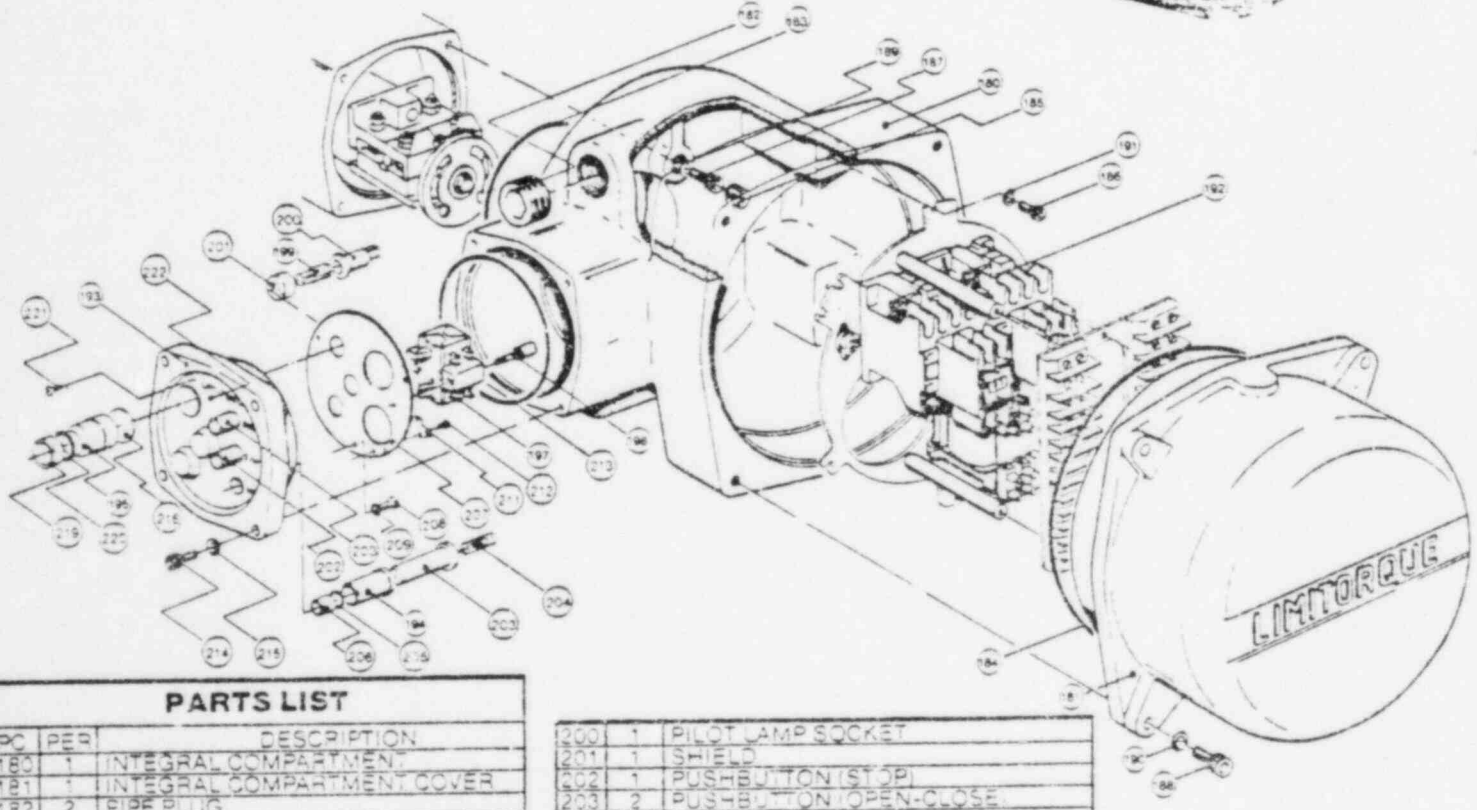
Integral Control



LIMIT SWITCH COMPARTMENT

INTEGRAL CONTROL MODULE ASSEMBLY





PARTS LIST

PC	PER	DESCRIPTION
180	1	INTEGRAL COMPARTMENT
181	1	INTEGRAL COMPARTMENT COVER
182	2	PIPE PLUG
183	1	O-RING
184	1	O-RING
185	4	PIPE PLUG
186	2	FILLISTER HEAD CAP SCREW
187	4	SOCKET HEAD CAP SCREW
188	4	SOCKET HEAD CAP SCREW
189	4	LOCKWASHER (HI-COLLAR)
190	4	LOCKWASHER (HI-COLLAR)
191	4	LOCKWASHER (HI-COLLAR)
192	–	INTEGRAL MODULE ASSEMBLY
193	1	HOUSING
194	2	FLANGED BEARING
195	3	LENS
196	1	PUSHBUTTON SWITCH
197	2	ROUND HEAD SCREW
198	1	PILOT LAMP

200	1	PILOT LAMP SOCKET
201	1	SHIELD
202	1	PUSHBUTTON (STOP)
203	2	PUSHBUTTON (OPEN-CLOSE)
204	3	SPRING
205	3	O-RING
206	3	SEAL RETAINER
207	1	SWITCH PLATE
208	3	FILLISTER HEAD MACHINE SCREW
209	3	LOCKWASHER
211	1	SPRING BRACKET (CLOSE)
212	4	SELF TAP SCREW
213	1	O-RING
214	4	SOCKET HEAD CAP SCREW
215	4	LOCKWASHER
216	1	LENS FILTER
217	3	SEAL RETAINER
218	3	O-RING
219	3	DRIVE SCREW
220	1	NAMEPLATE

LUBRICATION

Limitorque utilizes a totally sealed gear case factory-packed with grease. The gear case can be mounted in any position (as all penetrations into it are sealed); however those mounting positions which would cause vulnerable areas of the operator (e.g., motor limit switch compartment and torque switch or integral control compartment) to be saturated with lubricant should a seal failure occur should be avoided if possible and are not recommended.

No seal can remain absolutely tight at all times; therefore, it is not unusual to find a very small amount of weeping around shaft seals—especially during long periods of idleness such as storage. The use of grease minimizes this condition as much as possible. Should a small amount of weeping be found on start-up, it should be removed with a clean rag. Once the equipment has begun operating, this phenomenon should disappear.

Lubrication Inspection:

It is recommended that all Limitorque operators be inspected for proper lubrication prior to operating—especially if they have been stored for a long period of time.

The frequency of lubrication inspections should be based upon historical data on the installed equipment. Every operator application has its own effect on lubricants and each facility should pattern its inspections around its particular needs. The following schedule of lubrication inspection should be followed until operating experience indicates otherwise.

Main Gear Case: Inspect lubrication every 18 months or 500 cycles—whichever occurs first. Lubricate the Zerk fitting in the housing cover at the same interval.

Geared Limit Switch: Inspect lubrication every 36 months or 1000 cycles—whichever occurs first.

Inspection—The three primary considerations in a lubrication inspection are (1) Quantity; (2) Quality; (3) Consistency.

Quantity—Limitorque operators are built to operate on the partial immersion principle. The primary concern in the amount of lubricant is whether the "worm" is totally immersed in grease. This can be verified by the use of one or more of the many "fill" and "drain" plugs provided on the operator housing.

Quality—When removing a "fill" or "drain" plug to inspect the lube level, remove a small amount and ensure that it is clean and free of any contaminant including water. Should dirt, water or other foreign matter be found, the units should be flushed with a commercial degreaser/cleaner like Exxon VARSOL #1 or #3 which is non-corrosive and does not affect seal materials such as Buna N or Viton. Repack unit with fresh lubricant.

Consistency—The main gear box lubricant should be slightly fluid approximating a standard NLGI-1 grade consistency or less. Thinners such as Amoco WAYTAC #31 oil may be added provided the volume of thinner does not exceed 20% of the total lubricant.

The geared limit switch lube should be soft to the touch approximating an NLGI-2 consistency or less.

Factory Lubricants:

Gear Case: The standard SMC-04 actuator is factory lubricated with approximately 1 pound (.15 gallon) of Exxon Nebula EP0 calcium complex grease, suitable for temperatures from −20°F to +150°F. The SMC-03 is factory lubricated with approximately 1.5 pounds (.20 gallon). Geared Limit Switch: The limit switch is factory lubricated with Humble Oil Company Beacon 325. No substitute is recommended. Motor Bearings: Motors furnished with Limitorque Valve Controls have sealed, lubricated-for-life bearings.

Lubricant Substitute

The standard lubricants used by Limitorque have been proven extremely reliable over many years of service. There are, however, many other lubricants available which may be used IN LIEU OF the standard.

Typical commercially available lubricants other than those used by Limitorque for which manufacturers data indicates compatibility with Limitorque operators are shown below with the temperature range recommended by the manufacturer.

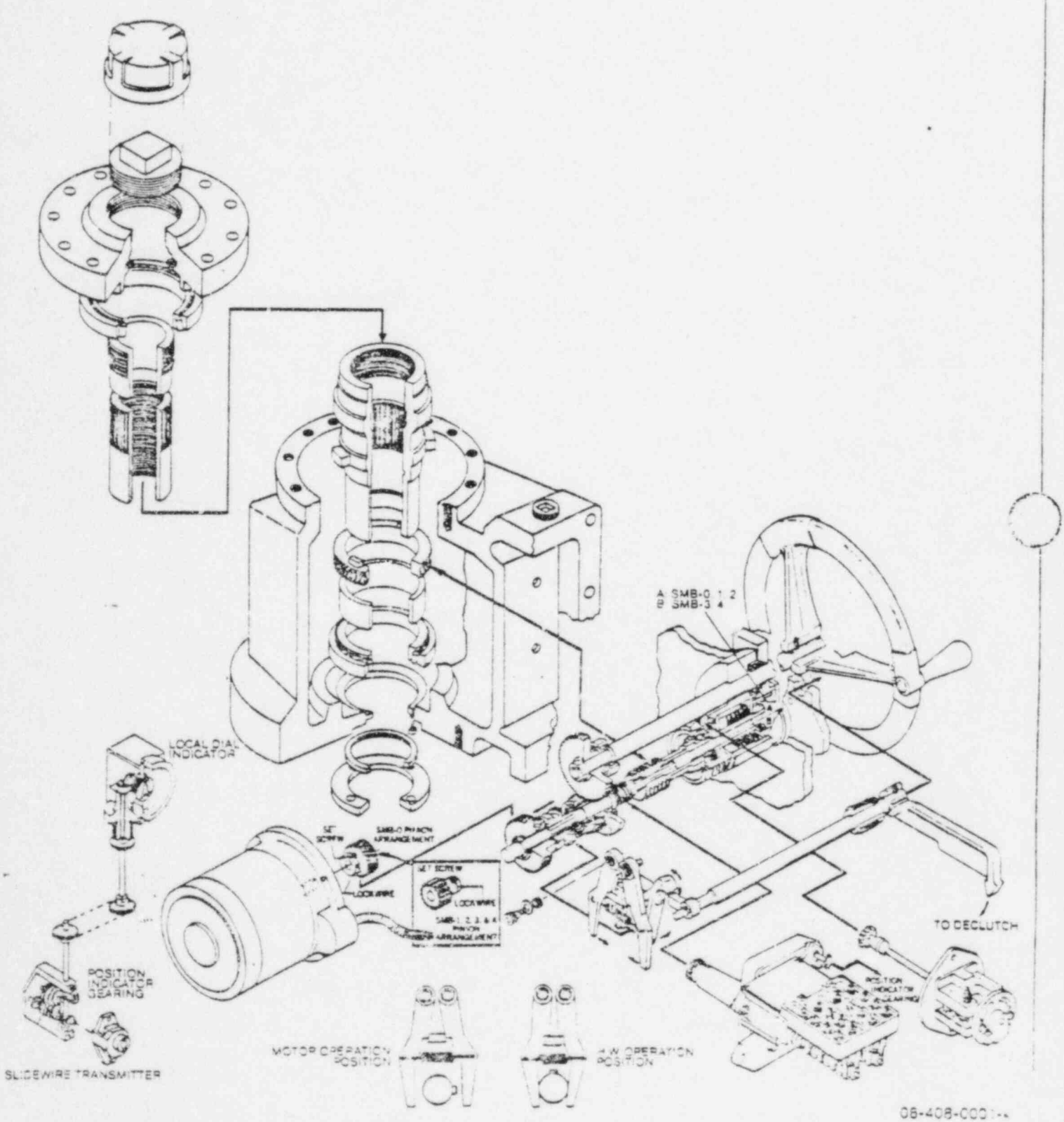
Do not add a different lubricant to a Limitorque operator unless it is of the same soap base as the existing lubricant unless you have received the approval of the lubricant manufacturer.

The minimum lubricant qualities required by Limitorque are:

1. Should contain an "EP" additive.
2. Must be suitable for the temperature range intended.
3. Must be water & heat resistant and non-separating.
4. Must not create more than 8% swell in Buna N or Viton.
5. Must not contain any grit, abrasive fillers.
6. Must slump—prefer NLGI Grade 1.
7. Must not be corrosive to steel gears, ball or roller bearings.
8. Dropping point must be above 300°F for temperature ranges of −20° to 150°F.

Manufacturer	Type	Temperature Range	Base
Exxon	Humble P290	−40°F to 120°F	Lithium Lime
Arco	Litholine HEP1	−10°F to 220°F	Lithium
Gulf Oil	Gulfcrown EP0	−20°F to 220°F	Lithium
Cities Service	City AP	− 0°F to 220°F	Lithium
Mobil Oil Co.	Mobilux EP0	−10°F to 220°F	Lithium 12
Shell Oil	Darina 0	−10°F to 250°F	Hydroxystearate No soap
Fiske	Lubriplate Low Temp	−40°F to 150°F	Lithium
Texaco	Marfak 0	−20°F to 200°F	Sodium
	Low Temp EP	−40°F to 200°F	Lithium
Tidewater Oil	Veedol Alitho 10	−10°F to 150°F	Lithium

SMB-0 TO SMB-4 & SMB-4T



SMB-0 TO SMB-4 & SMB-4T
REASSEMBLY

Reassembly:

To reassemble, follow the above procedure in the reverse order noting the following:

Follow gasketing instructions below.

20. Be sure to stack Belleville discs, thrust washers, and whatever spacers were removed in the exact order as they were removed.

22. Reinstall elastic stop nut, pc #85, with the same number of turns as were used to remove.

17. To replace declutch link, pc #9, be sure to align with declutch lever, pc #10, to assure correct positioning of lever.

16. When replacing worm shaft clutch, pc #50, be sure to install with smaller set of lugs first, to engage with lugs on handwheel clutch pinion, pc #42.

10. When worm is replaced, it may be easier to rotate worm shaft clutch, pc #50, to engage splines on worm shaft. Then place unit in manual operation by replacing declutch lever, pc #10, and handwheel temporarily and rotate handwheel in opposite direction used to remove worm.

9. Before replacing end cap, align torsion spring, pc #54 which holds declutch lever in its normal position. Remove declutch lever and replace end cap, pc #4, and spring cartridge plate with gasket, pcs #71 and 72, but do not bolt up tight. Allow 3/8" space between end cap and housing and replace declutch lever. Depress declutch lever in manual operation and while holding down declutch lever, secure end cap, pc #4.

5. When reinstalling the motor pinion, pc #40, insure it is a tight fit on the motor shaft (preferably a light press fit). Note that the SMB-0 motor pinion is installed with the set screw lockwire between the gear teeth and the motor flange. On the SMB-1 through 4, the gear teeth are between the set screw/lockwire and the flange.

To Replace the Stem Nut Only: If the stem nut, pc #11, is to be removed from the assembled Limitorque Valve Control it is necessary to remove the locking nut, pc #30, and then remove stem nut by lifting out top of unit.

WARNING! Do not remove locknut, pc #30, with unit under load or with valve under pressure. (See warning for Step 11.)

The locknut, pc #30, is staked in two places so it will be necessary to locate the stakes and spot with a drill. Clean all metal particles and remove. If Limitorque is mounted on a valve having a threaded stem and removal of the stem nut is required, merely remove the locking nut, pc #30, as mentioned above, then rotate the handwheel of the Limitorque operator to close the valve. The stem nut will rise up the threaded stem of the valve. When the stem nut splines are free from the drive sleeve, the stem nut may be rotated by hand the remainder of the length of the valve stem and replaced, if necessary. When new stem nut is installed with pc #30, stake the top threads in two places.

If valve must be left in service while the stem nut is replaced, the valve stem must be locked in such a way as to prevent any movement of valve stem.

Gasketing Instructions: All gaskets except the housing cover gaskets are 1/32" thick anchorite. The housing cover gaskets vary in thickness and to determine correct size follow the following procedure:

1. Clean both housing cover and main housing gasketed surface.

2. Install unit drive sleeve assembly complete with bearings.

3. Install housing cover and measure the gap between the housing cover and the main housing.

4. Take measurement found in Step 3 and add 10% to it and use the closest nominal gasket thickness or combination available

TORQUE SWITCH

Procedure for Setting

CAUTION: Disconnect all incoming power to the Limitorque prior to removing torque switch cover, #89 or working on the torque switch. If unit is "torqued out," release torque build up by putting unit in handwheel operation.

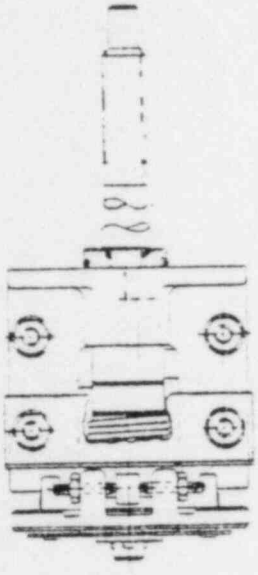
The torque switch is factory set according to information provided at time of order and a torque switch calibration tag similar to that illustrated below is located in the torque switch cover.

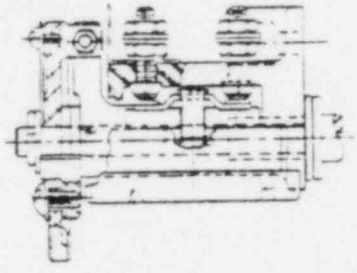
To change the switch setting:

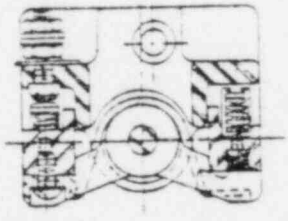
1. For either the open or close direction loosen Screw "A" and move Pointer "B" to the number setting corresponding to the torque required. The higher the number, the higher the output torque and/or thrust of the unit.
2. Tighten Screw "A".

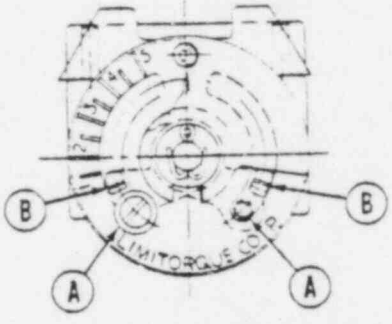
CAUTION: A maximum stop setting plate is provided on most units. Do not remove. Do not exceed the setting indicated by the stop plate without contacting Limitorque.

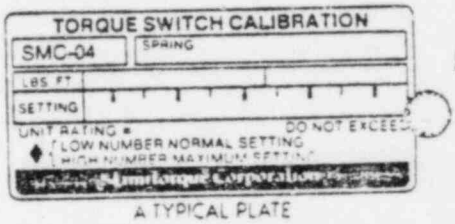
3. Operate valve electrically to seat valve and to insure tight shut-off.











A TYPICAL PLATE

Stem Nut Replacement:

The Limitorque Valve Control stem nut may occasionally require replacement when used in a threaded stem application. You may replace the stem nut without removing the actuator from the valve or the valve from the pipe by following the procedure below.

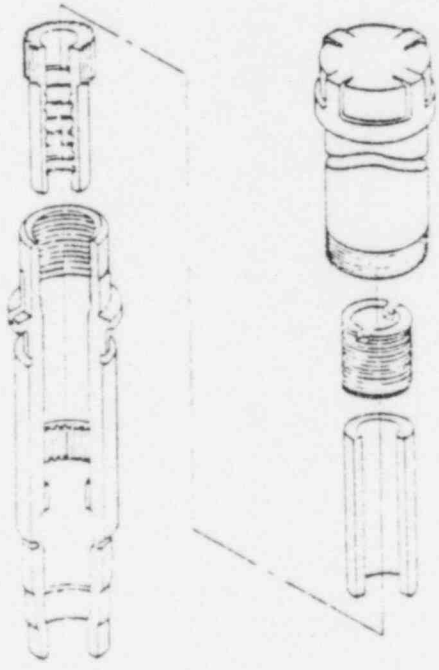
CAUTION: Disconnect all electric power to the Limitorque before beginning work.

1. Place valve in the open position for upward opening valves. For downward opening or special valves, consult factory.

WARNING: If the valve is not placed in the open position to remove the stem nut, the valve stem may rise suddenly when the lock nut is removed if pressure is in the pipe and/or if the operator is mounted upside down.

2. Remove stem cover or pipe plug if one is in place.
3. Stem Nut #11 is held in place by Lock Nut #12. The lock nut is secured in place by two stakes in the top threads of the drive sleeve. Spot drill the stakes and remove the lock nut by turning counterclockwise.
4. Manually operate the valve in the close direction driving the stem nut and Stem Nut Spacer #13 up the threaded valve stem until the stem nut splines are free of the drive sleeve splines. Remove the stem nut spacer. (The top of the nut has two slots for rotating it off the valve stem.)
5. Continue to thread the stem nut up the valve stem by hand until free and remove.
6. Install replacement stem nut by threading it down the valve stem by hand until the stem nut splines mate with the drive sleeve splines.
7. Manually operate the valve in the open direction driving the stem nut down the valve stem until the stem nut seats in the drive sleeve.
8. Replace the stem nut spacer. Replace the lock nut and turn clockwise until tight. The top of the lock nut should be flush with the top of the drive sleeve. Using a punch, stake the lock nut in place at two points approximately 180° apart.
9. Reset the geared limit switch per instructions elsewhere in this manual.

CAUTION: If locknut is not properly "staked", actuator may fail to function properly.



GEARED LIMIT SWITCH

CAUTION: The geared limit switch is not preset at the Limitorque factory, but must be set while on its associated equipment.

Disconnect all incoming power to the Limitorque prior to removing limit switch compartment cover, #85 or attempting to work on the limit switch.

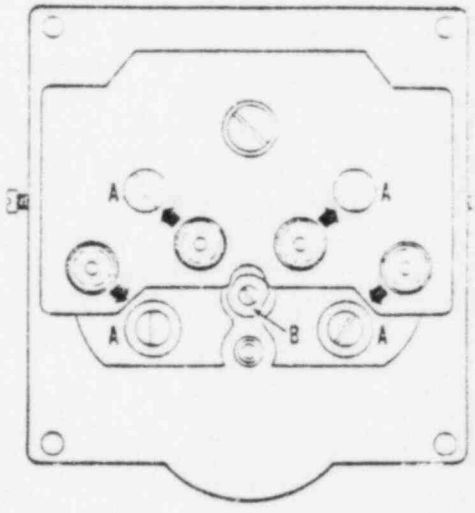
Consult applicable wiring diagram for limit switch contact development.

To set the switch:

1. Remove Compartment Cover, #85.
2. Put the Limitorque into manual operation, and use the handwheel to operate the valve in the "Open" direction. While operating the valve, note direction of rotation of Intermittent Gear Shaft "A" corresponding to the rotor to be set.
3. When the valve is fully open, close it one turn of the handwheel to allow for coast of moving parts.
4. Turn Setting Rod "B" clockwise with a screwdriver until it reaches a stop position. (DO NOT FORCE)
5. Refer to applicable wiring diagram for contact development. If the rotor to be set has not turned 90° to open the contacts which are to open at this point, turn Intermittent Gear Shaft "A" corresponding to this rotor in the same direction as noted in Step 2 above. If the rotor has already turned 90° to open the contacts which are to open at this point, turn Intermittent Gear Shaft "A" corresponding to this rotor in the opposite direction to that noted in step 2 above. Leave the Intermittent Gear Shaft at the point where the contacts cleanly trip. This rotor is now set at the correct position.
6. Turn Setting Rod "B" counter-clockwise until it stops. Check the Intermittent Gear Shaft to insure it is tight and will not move. (DO NOT FORCE) The rotor is now set.
7. Set the other rotors corresponding to required valve positions and trip points following the above procedure.

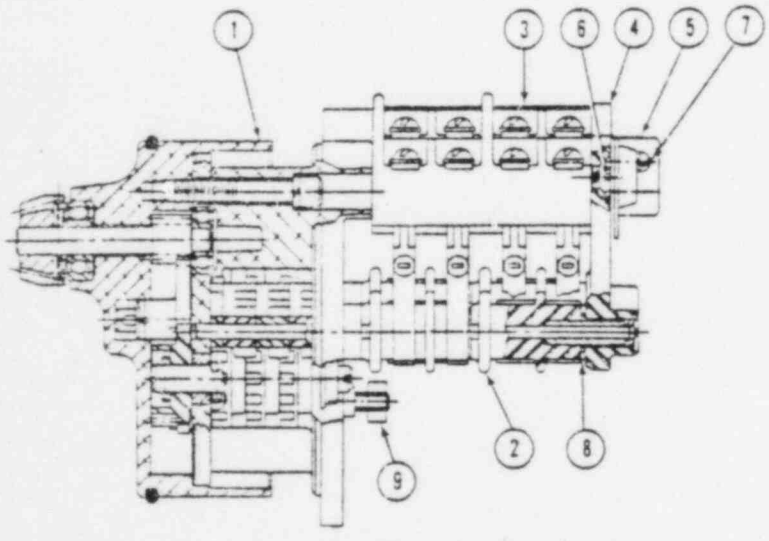
CAUTION: Do not operate the valve manually or electrically with setting rod "B" in the clockwise (fully in) position or rotor settings already made will be lost.

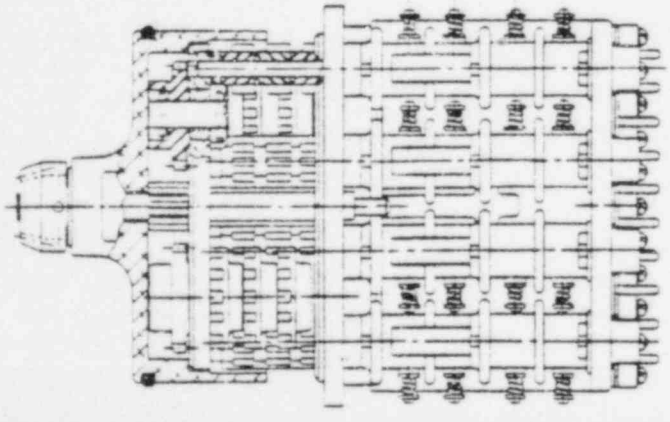
8. The rotor segments can be separated and rotated 90° to give various combinations of normally open or normally closed contacts on each rotor. Proceed as follows.
   A. Remove two Slotted Round Head Screws, #5 and Lockwasher and Terminal Strip, #4.
   B. Remove Flat Head Screw, #6 and Plate #7. CAUTION: Watch for and do not lose rotor spacers, #8.
   C. Pull out rotors, pull apart and position as required.
   D. Reassemble carefully in reverse order.

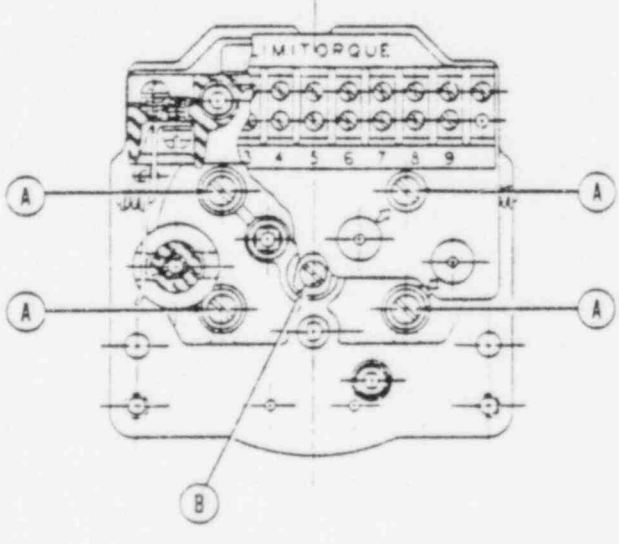


1.	Gear Frame Assembly	5 **	Slotted Round Head Screw and Lockwasher
2.*	Rotor Kit	6 **	Flat Head Screw
3.*	Contact and Terminal Block Assembly	7 **	Rotor Plate
4	Terminal Strip	8 **	Rotor Spacer

*Specify whether existing unit has two or four contacts per rotor.
**Reference only, not available as separate items.

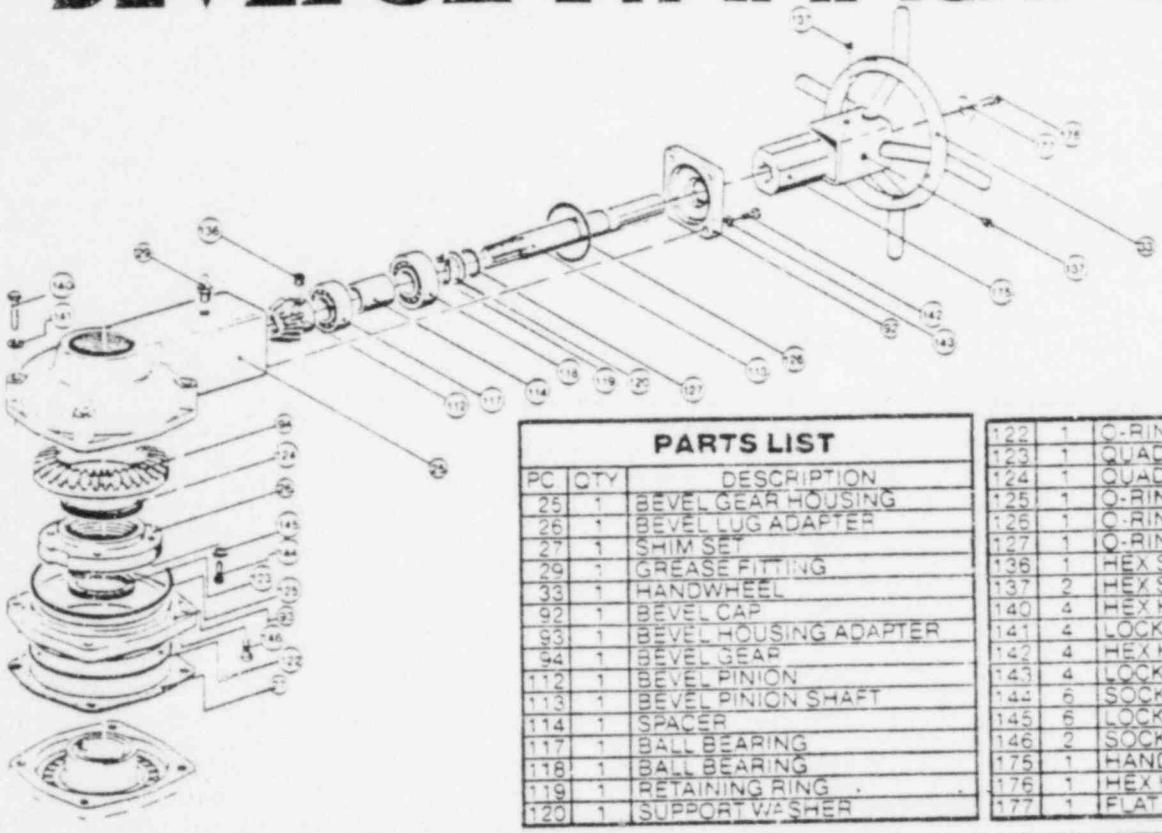






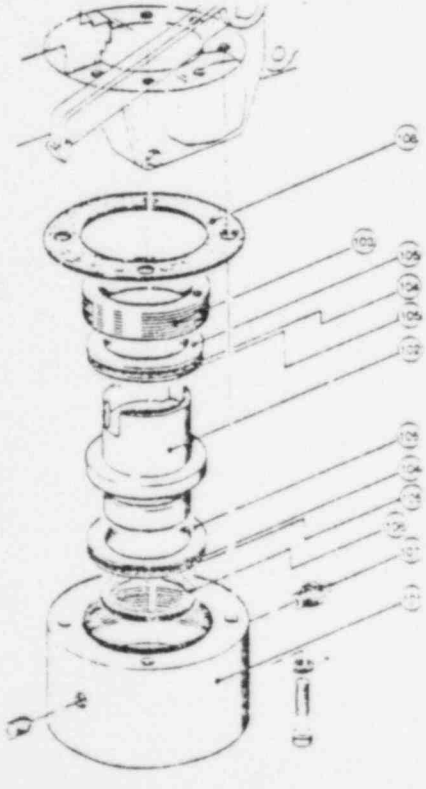
SPARE PARTS LIST	
ITEM	DESCRIPTION
1	GEAR FRAME ASSEMBLY
2	ROTOR KIT
3	CONTACT AND TERMINAL ASSY KIT
4	TERMINAL STRIP

SMC-03 HANDWHEEL BEVEL GEAR ATTACHMENT



PARTS LIST		
PC	QTY	DESCRIPTION
25	1	BEVEL GEAR HOUSING
26	1	BEVEL LUG ADAPTER
27	1	SHIM SET
29	1	GREASE FITTING
33	1	HANDWHEEL
92	1	BEVEL CAP
93	1	BEVEL HOUSING ADAPTER
94	1	BEVEL GEAR
112	1	BEVEL PINION
113	1	BEVEL PINION SHAFT
114	1	SPACER
117	1	BALL BEARING
118	1	BALL BEARING
119	1	RETAINING RING
120	1	SUPPORT WASHER
122	1	O-RING
123	1	QUAD RING
124	1	QUAD RING
125	1	O-RING
126	1	O-RING
127	1	O-RING
136	1	HEX SOCKET SET SCREW
137	2	HEX SOCKET SET SCREW
140	4	HEX HEAD CAP SCREW
141	4	LOCKWASHER
142	4	HEX HEAD CAP SCREW
143	4	LOCKWASHER
144	6	SOCKET HEAD CAP SCREW
145	6	LOCKWASHER
146	2	SOCKET HEAD CAP SCREW
175	1	HANDWHEEL BUSHING
176	1	HEX HEAD CAP SCREW
177	1	FLAT WASHER

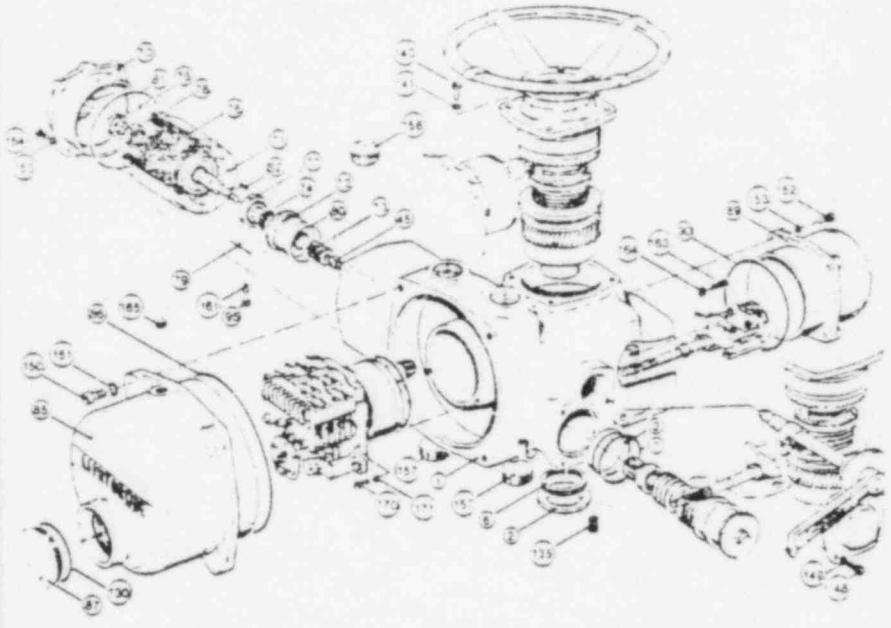
SMC-04 THRUST BASE ATTACHMENT



PARTS LIST		
PC	QTY	DESCRIPTION
101	1	THRUST ADAPTER
102	1	STEM NUT
103	1	LOCKNUT
104	2	THRUST BEARING
105	4	THRUST WASHER
106	1	QUAD RING
107	1	GREASE FITTING
108	1	GASKET

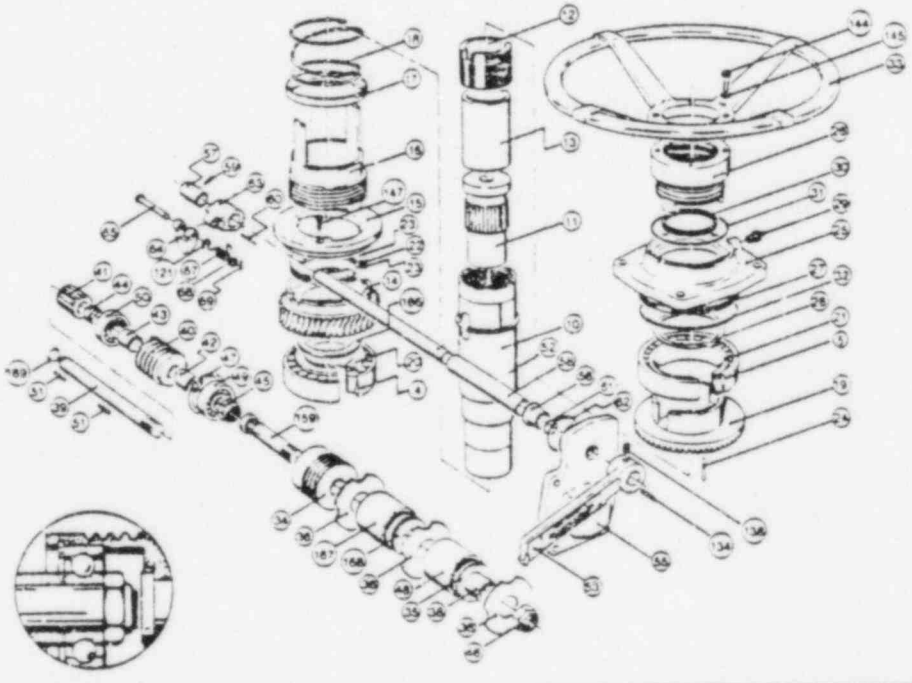
SMC-03

PARTS LIST		
PC	PER	DESCRIPTION
1	1	HOUSING
2	1	SEAL RETAINER
3	1	QUAD RING SPACER
6	1	QUAD RING
7	1	QUAD RING
45	1	FLEXLOC NUT
70	1	MOTOR END BELL
71	1	ROTOR & SHAFT
72	1	BEARING ADAPTER
73	1	MOTOR PINION
74	1	OIL SEAL
75	4	"K" DISC SPRING
76	1	STATOR
77	1	BALL BEARING
78	1	BALL BEARING
79	1	STATOR SHIELD
80	1	O-RING
81	1	O-RING
82	1	KEY
85	1	LIMIT SWITCH COMPARTMENT COVER
86	1	O-RING
87	1	DIAL WINDOW
89	1	TORQUE SWITCH COMPARTMENT COVER
90	1	O-RING
95	1	HEX SOCKET PIPE PLUG
130	1	O-RING
135	4	HELICOIL INSERT
140	4	HEX HEAD CAP SCREW
141	4	LOCKWASHER
148	4	HEX HEAD CAP SCREW
149	4	LOCKWASHER
150	4	SOCKET HEAD CAP SCREW
151	4	LOCKWASHER
152	4	SOCKET HEAD CAP SCREW
153	4	LOCKWASHER



154	4	SOCKET HEAD CAP SCREW
155	4	LOCKWASHER
156	2	PIPE PLUG
157	2	PIPE PLUG
161	1	HEX SOCKET SET SCREW
163	1	FILLISTER HEAD CAP SCREW
164	1	LOCKWASHER
165	1	PIPE PLUG
170	2	FILLISTER HEAD CAP SCREW
171	2	LOCKWASHER (HI COLLAR)

PARTS LIST		
PC	PER	DESCRIPTION
4	1	BEARING CUP (LOWER)
5	1	BEARING CUP (UPPER)
10	1	DRIVE SLEEVE
11	1	STEM NUT
12	1	LOCKNUT
13	1	STEM NUT SPACER
14	1	WORM GEAR
15	1	ECCENTRIC RING
16	1	CLUTCH SLEEVE
17	1	SPRING CUP
18	1	COMPRESSION SPRING
19	1	BEVEL GEAR
20	1	BEARING CONE (LOWER)
21	1	BEARING CONE (UPPER)
22	1	THRUST BEARING
23	2	THRUST RACE
24	1	KEY
25	1	HOUSING COVER
27	1	SHIM SET
28	1	RETAINING RING
29	1	GREASE FITTING
30	1	QUAD RING
31	1	O-RING
32	1	O-RING
33	1	HANDWHEEL
34	1	BEARING CARTRIDGE
35	9	DISC SPRING
36	3	THRUST WASHER
38	1	GUIDE SLEEVE
39	1	WORM SHAFT
40	1	WORM
41	1	WORM SHAFT GEAR
42	1	WORM SPACER
43	1	WORM SPACER
44	1	GEAR SPACER
45	1	FLEXLOC NUT
46	1	FLEXLOC NUT
47	1	RETAINING RING
48	1	TORQUE LIMIT SLEEVE
49	1	BALL BEARING
50	1	BALL BEARING
51	2	KEY



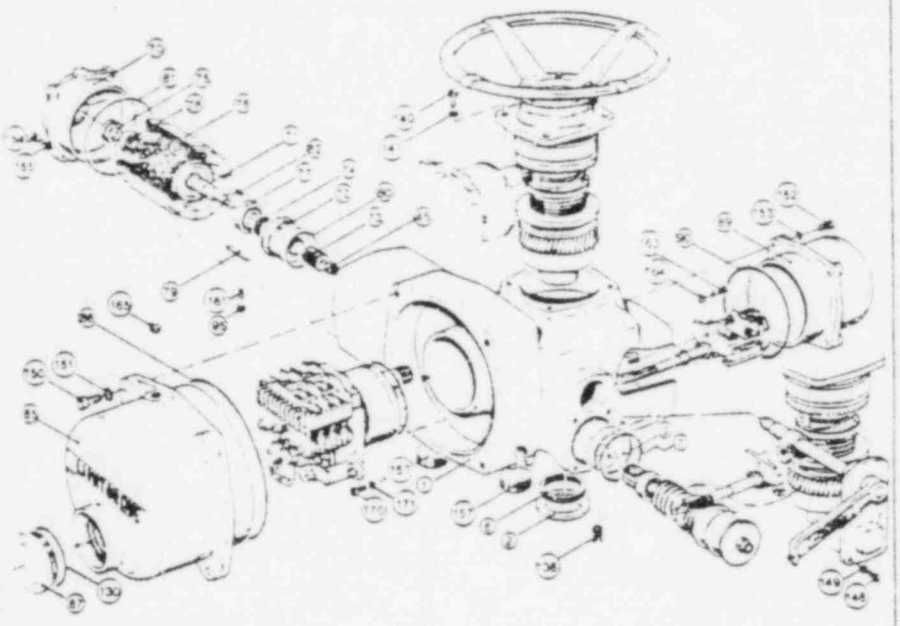
52	1	DECLUTCH SHAFT
53	1	DECLUTCH LEVER
55	1	DECLUTCH SHAFT CAP
56	1	FLANGE BEARING
57	1	SPACER
58	1	SPACER
59	1	ROLL PIN
60	1	KEY
61	1	QUAD RING
62	1	O-RING
63	1	LATCH PINION
64	1	LATCH
65	1	CLEVIS PIN

67	1	TORSION SPRING
68	1	FLAT WASHER
69	1	COTTER PIN
121	1	RETAINING RING
134	1	KEY
138	1	SOCKET SET SCREW
144	4	HEX HEAD CAP SCREW
145	4	LOCKWASHER
147	2	SOCKET HEAD CAP SCREW
159	1	CARTRIDGE STEM
165	1	WORM GEAR SPACER
167	1	TORQUE LIMIT SLEEVE
168	1	DISC SPRING

SMC-04

PARTS LIST

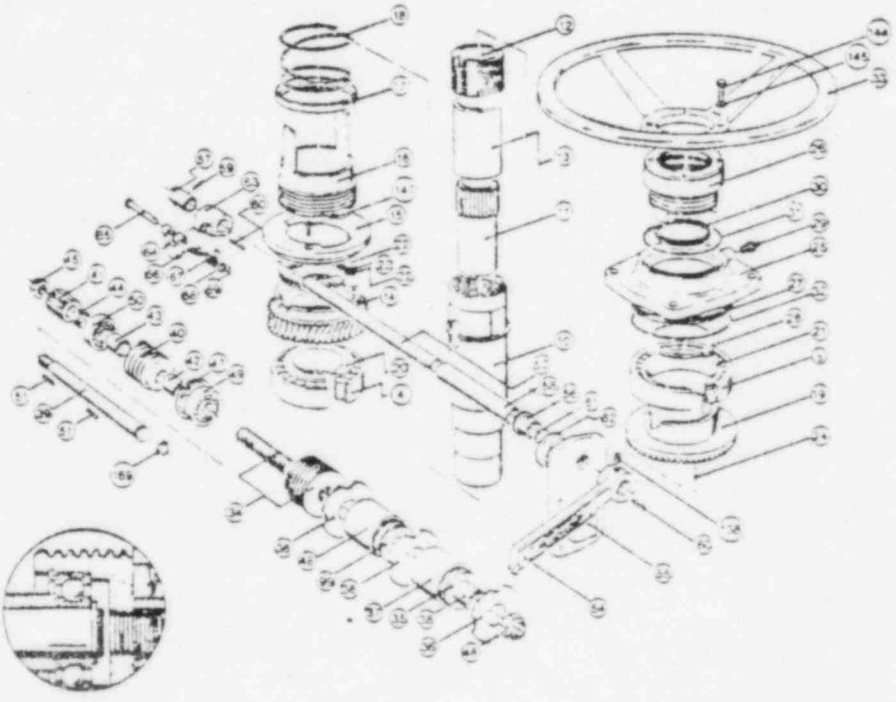
PC	PER	DESCRIPTION
1	1	HOUSING—MACHINED
2	*	SEAL RETAINER
3	1	QUAD RING SPACER (LOWER)
6	1	QUAD RING
7	1	QUAD RING
45	1	FLEXLOC NUT
70	1	MOTOR END BELL
71	1	MOTOR SHAFT & ROTOR
72	1	BEARING ADAPTER
73	1	MOTOR PINION
74	1	OIL SEAL
75	4	K-DISC SPRING
76	1	STATOR
77	1	BALL BEARING
78	1	BALL BEARING
79	1	STATOR SHIELD
80	1	O-RING
81	1	O-RING
82	*	KEY
85	1	LIMIT SWITCH COMPARTMENT COVER
86	1	O-RING
87	1	DIAL WINDOW
89	1	TORQUE SWITCH COMPARTMENT COVER
90	1	O-RING
95	5	PIPE PLUG
130	1	O-RING
135	8	HELICOIL INSERT
140	4	HEX HEAD CAP SCREW
141	4	LOCKWASHER (INT-TOOTH)
146	4	HEX HEAD CAP SCREW
149	4	LOCKWASHER (INT. TOOTH)
150	4	SOCKET HEAD CAP SCREW
151	4	LOCKWASHER (HI COLLAR)
152	4	SOCKET HEAD CAP SCREW
153	4	LOCKWASHER (HI COLLAR)



154	4	SOCKET HEAD
155	4	LOCKWASHER (HI COLLAR)
157	2	PIPE PLUG
161	1	SOCKET HEAD SET SCREW
163	1	FILLISTER HEAD CAP SCREW
164	1	LOCKWASHER (HI COLLAR)
165	1	PIPE PLUG
170	2	FILLISTER HEAD CAP SCREW
171	2	LOCKWASHER (INT. TOOTH)

PARTS LIST

PC	PER	DESCRIPTION
4	1	BEARING CUP (LOWER)
5	1	BEARING CUP (UPPER)
10	1	DRIVE SLEEVE
11	1	STEM NUT
12	1	LOCKNUT
13	1	SPACER (STEM NUT)
14	1	WORM GEAR
15	1	ECCENTRIC RING
16	1	CLUTCH SLEEVE
17	1	SPRING CUP
18	1	COMPRESSION SPRING
19	1	BEVEL GEAR
20	1	BEARING CONE (LOWER)
21	1	BEARING CONE (UPPER)
23	1	THRUST BEARING SUB-ASSEMBLY
24	1	KEY (ROUND ENDS)
25	1	HOUSING COVER
26	*	HANDWHEEL ADAPTER
27	*	SHIM SET
28	1	RETAINING RING
29	1	GREASE FITTING
30	*	QUAD RING
31	1	O-RING
32	1	O-RING
33	1	HANDWHEEL
34	*	BEARING CARTRIDGE
35	1	DISC SPRING PACK
36	3	THRUST WASHER
37	1	TORQUE LIMIT SLEEVE
39	1	GUIDE SLEEVE
40	*	WORM SHAFT
40	*	WORM
41	1	SPUR GEAR
42	2	WORM SPACER
43	2	WORM SPACER
44	*	SPUR GEAR SPACER
45	1	FLEXLOC NUT
46	1	FLEXLOC NUT
47	*	RETAINING RING
48	*	TORQUE LIMIT SLEEVE
49	1	BALL BEARING
50	1	BALL BEARING



51	2	KEY (SQUARE ENDS)
53	*	DECLUTCH SHAFT
54	1	DECLUTCH LEVER
55	1	DECLUTCH SHAFT CAP
56	1	PLUNGER BEARING
57	1	SPACER
58	*	SPACER
59	1	ROLL PIN
60	2	KEY (SQUARE ENDS)
61	*	QUAD RING
62	1	O-RING
63	*	LATCH PINION

64	1	LATCH
65	1	CLEVIS PIN
66	1	HANDLE
67	1	COMPRESSION SPRING
68	1	FLAT WASHER
69	1	COTTER PIN
99	*	DISC SPRING PACK
138	1	HEX SOCKET SET SCREW
144	4	HEX HEAD CAP SCREW
145	4	LOCKWASHER (HI COLLAR)
166	1	RETAINING RING

DISASSEMBLY PROCEDURE

Disassembly:

CAUTION: Do not attempt to work on the Limitorque valve control until all power sources have been shut off. If necessary, you may replace the geared limit switch, torque switch, declutch shaft sub-assembly, motor, or stem nut while the valve control is mounted on the valve. For other work, it is recommended that the actuator be removed from the valve.

Do not remove housing cover, drive sleeve lock nut, or unit mounting bolts when the unit is mounted on a rising stem valve unless the valve is in the full open position.

To completely disassemble the SMC-04, proceed as follows:

1. Shut off all power to the unit.
2. Remove Limit Switch Compartment Cover #85 and Torque Switch Cover #89.
3. Disconnect all electrical leads in both compartments, making sure all leads and terminals are properly marked to facilitate reassembly.
4. Remove one grease plug from the unit housing to allow for equalization of air pressure. Remove one bolt holding in torque switch and two bolts holding in geared limit switch and remove switches.
5. Remove four screws and Motor End Bell, #70. Remove three "K" Disc Springs, #75.
6. Remove Rotor and Shaft subassembly #71.
7. Remove "O" Ring, #80.
8. If Spur Gear, #70 on the motor shaft subassembly is to be replaced, remove Flexloc Nut, #45.
9. If Motor Stator, #76 is to be removed or replaced, consult factory.
10. Remove four bolts and Declutch Shaft Cap, #55. Remove declutch shaft subassembly.
11. Remove Quad-ring Spacer #3 and Quad-ring, #7.
12. Pull torque spring and worm shaft subassembly approximately one inch until Ball Bearing, #50 hits Worm Gear, #14.
13. Remove four bolts and Housing Cover, #25.
14. Lift drive sleeve subassembly approximately one inch and pull out torque spring and worm shaft subassembly.
15. Remove drive sleeve subassembly.
16. To reassemble the unit, follow the above procedure in reverse with special care when assembling the declutch shaft subassembly to have the lower lugs on the Clutch Sleeve, #16 engaged with the internal grooves on the Eccentric Ring, #15. Rotate clutch sleeve by hand, if necessary, to get in engagement with the eccentric ring. Make sure the arrow cast on the face of Declutch Lever, #53 is pointing towards the mounting base of the unit, when the declutch shaft subassembly has been installed into the unit.

How to Order Parts:

To obtain further information or order parts for your Limitorque Valve Control, contact your local representative or write to:

Limitorque Corporation
5114 Woodall Road
Lynchburg, Virginia 24502
Attention: Manager, Parts and Service
(804) 528-4400
Telex 82-9448

All inquiries or orders MUST be accompanied by the following information which can be obtained from the unit name plate.

Unit Size and Type
Serial Number
Limitorque Corporation Order Number

TYPICAL OPERATION

Description of Motor Operation:

Your Limitorque actuator is always available for motor operation whenever the motor is energized. Do not force declutch lever into "motor operation position. **Lever returns to this position automatically when motor is energized.**

Motor Pinion, =73 drives Spur Gear, =41 on the end of Worm Shaft, =39. Worm, =40 is keyed to Worm Shaft which drives Worm Gear, =14.

Two grooves in the top portion of the worm gear engage two lugs in Eccentric Ring, =15. The Ring has two internal lugs which engage two lugs on Clutch Sleeve, =16. Spacing of these lugs provides lost motion or the "hammerblow" effect.

The Clutch Sleeve also has two long lugs on the top portion which engage Bevel Gear, =19 thru two keyways in the ID. The Bevel Gear and Drive Sleeve, =10 are engaged and driven together through Key, =24.

When the above pieces are fully engaged, the Drive Sleeve rotates Stem Nut, =11 thru splines on the ID of the Drive Sleeve and the OD of the Stem Nut. This in turn will rotate the shaft in a keyed Stem Nut or cause a threaded shaft to translate in a threaded Stem Nut.

Thrust is absorbed by Bearings, =4/20 and =5/21 on the top and bottom of the Drive Sleeve. As torque is developed, the Worm and Shaft move axially compressing Belleville Springs, =35. The spring assembly is calibrated such that a finite compression represents a finite torque. Compression of the Springs causes movement of Bearing Cartridge, =34 which is geared to Torque Switch, =88. The Torque Switch is graduated and adjustable so it can be set to interrupt power to the motor at a predictable, predetermined torque level.

Geared Limit Switch, =84 is direct driven by the Bevel Gear and Drive Sleeve and, therefore, once properly set, is always in step with the valve position, whether the Limitorque is in electric or manual operation.

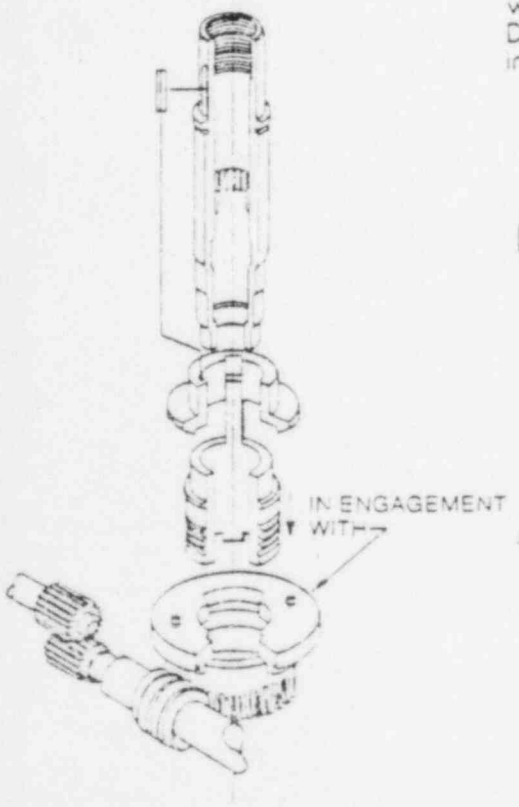
Description of Manual Operation:

Your Limitorque Valve Control has a handwheel for manual operation. The unit can be manually operated any time the motor is not energized. To manually operate the Limitorque, turn Declutch Lever, =53 counterclockwise approximately 90° until it latches. If the Declutch Lever will not turn 90° or it does not latch, DO NOT FORCE. Rotate Handwheel, =33 slightly while turning the Declutch Lever and the Lever will latch in place.

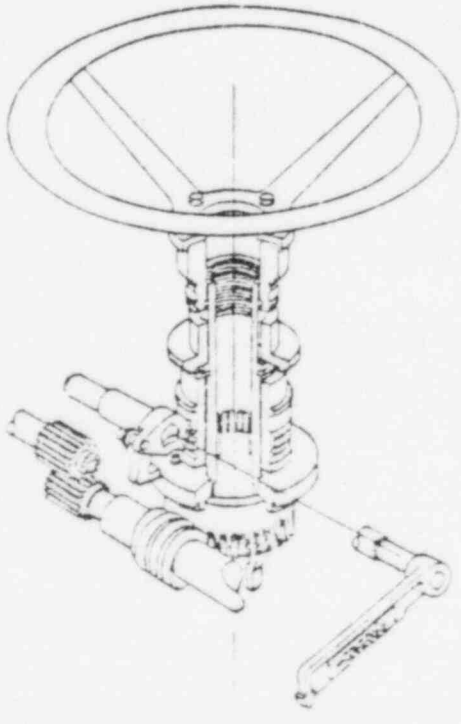
When the Declutch Lever is latched in place, Clutch Sleeve, =16 is moved upward until its upper lugs engage the lugs in the bottom of Handwheel Adaptor, =26. This position is maintained indefinitely by Latch, =64, Latch Pinion, =63 and the cam surface on Eccentric Ring, =15.

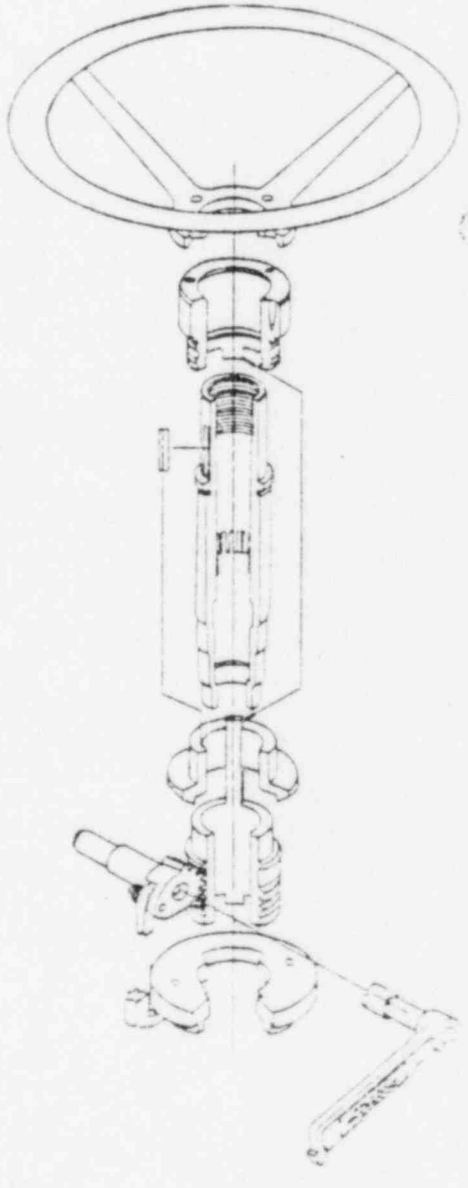
CAUTION: Do not try to force the Declutch Lever into the motor operation position.

When the motor is energized, the Eccentric Ring is rotated, its cam surface moves the Latch, releasing the Clutch Sleeve which is pushed into motor operation by Clutch Spring, =18.



MOTOR OPERATION





MANUAL OPERATION

INSTALLATION TIPS

CAUTION

DO NOT ATTEMPT TO STORE, INSTALL OR OPERATE YOUR LIMITORQUE VALVE CONTROL WITHOUT READING THE INSTRUCTION TIPS; DO'S AND DON'TS; AND CAUTIONARY NOTES BELOW.

CAUTION: Do not remove housing cover, drive sleeve lock nut, or unit mounting bolts when the unit is mounted on rising stem valve unless valve is in the full open position, or there is not or cannot be any pressure in the line involved.

Limit switches are not factory set by Limitorque. They must be set when unit is mounted on valve.

Short Term Storage (Less than one year):

Units are not weatherproof until properly installed or prepared for storage.

Actuators should be stored in a clean, dry, protected warehouse free from excessive vibration and rapid temperature changes. If actuators must be stored outdoors, they must be stored off the ground, high enough to prevent their being immersed in water or buried by snow.

Connect internal heaters (when supplied), or place desiccant in limit switch compartment. Replace all plastic caps or plugs with pipe plugs. Ensure all covers are tight. If mounted on valve and stem protrudes from unit, suitable stem cover must be in place.

Unit should be stored with motor and limit switch compartment horizontal or vertically above unit centerline.

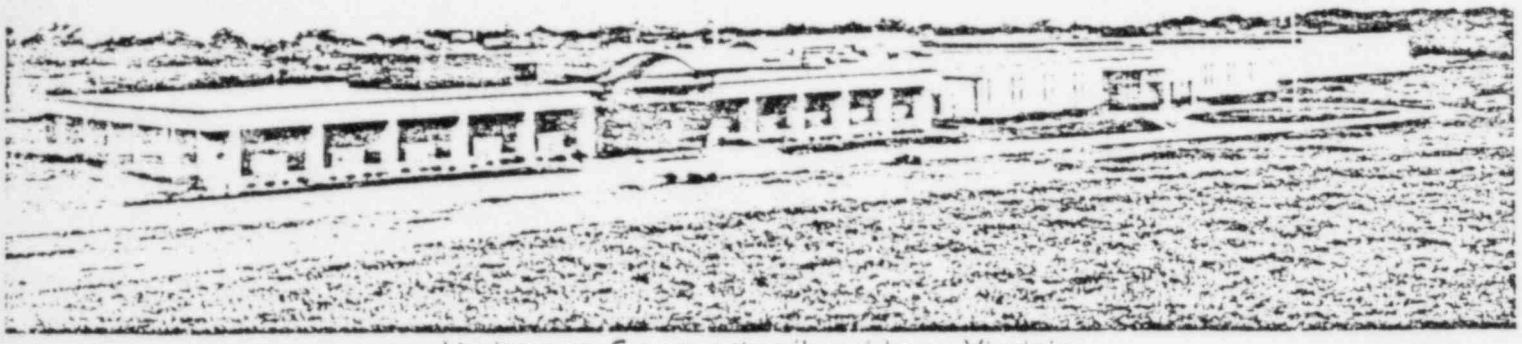
Failure to comply with recommended storage procedure will void warranty. For long term storage, consult Limitorque form P-323.

DO:

1. Mount motors on a horizontal plane if possible. Preferred mounting positions are with the motor and limit switch compartment horizontal or vertically up.
2. Check to be sure stem nut is secured tightly by locking nut and that top thread of lock nut is crimped or staked in two places.
3. Keep limit switch compartment clean and dry.
4. Set open and close limit switches according to instructions by operating the valve with unit handwheel.
5. Check all unit wiring to ensure it coincides with applicable wiring diagram.
6. Carefully check limit switch operation in conjunction with motor rotation. If motor is driving valve in the wrong direction, interchange any two leads on three phase motors or switch the armature leads on D.C. or single phase motors.
7. Keep geared limit and torque switch contacts clean. Use "CRC Lectra Clean" or other suitable solvent on a lint-free cloth.
8. Check valve stem travel and clearance when fully open before mounting stem protection cover on rising stem valves. All stems should have protective cover.
9. Replace all molded plastic conduit and top protectors (installed for shipping protection only) with pipe plugs when installation wiring is completed.
10. **CAUTION:** Shut off incoming power before removing or replacing limit switch compartment cover.
11. Set up a periodic operating schedule (suggest 1 per month) for your Limitorque if the valve is infrequently used.
12. Lubricate the drive sleeve top bearing every twelve months using a grease gun on the pressure fitting on the housing cover.
13. Keep the valve stem clean and properly lubricated.
14. Reset the geared limit switch prior to motor operation if the Limitorque has been dismantled or removed from the valve.
15. Always relubricate after disassembly following lubrication instructions.

DON'T:

1. CAUTION: Do not attempt to work on your Limitorque without first shutting off incoming power.
2. Do not attempt to work on your Limitorque while it is on a torque seated valve. When removing the housing cover, stem nut, lock-nut, or mounting bolts, the valve should be in the fully open position.
3. Do not motor operate valve without first setting or checking limit switch settings and direction of motor rotation.
4. Do not try to force declutch lever from hand operation position to motor operation position.
5. Do not force declutch lever into hand operation position. LEVER AND UNIT RETURN TO MOTOR OPERATION AUTOMATICALLY WHEN MOTOR IS ENERGIZED.
6. Do not use a cheater on the handwheel.
7. Do not use abrasive cloth or paper to clean silver contacts of geared limit switch or torque switch.
8. Do not run 90° rotation type valves against stops as this may damage valve.
9. Do not torque seat 90° rotation valves without consulting valve manufacturer.
10. Do not alternately start and stop motor to open or close a valve too fast for normal operation.
11. Do not reset torque switch to a setting higher than the maximum recommended by the factory.
12. Do not attempt to repair gearing in limit switch. Replace entire gear frame assembly if necessary.



Limitorque Corporation/Lynchburg, Virginia

Your Limitorque Valve Control...

Limitorque is the most advanced valve control on the market - the result of many years of constant improvement and development. This booklet has been prepared to help you obtain the most benefit and use from your Limitorque valve controls. It contains instructions on the installation and maintenance of these units, plus helpful suggestions enabling you to become thoroughly familiar with the location and proper use of operating controls. Before you do anything be sure to read this booklet through at least once, then always keep it handy for ready reference.

Limitorque controls the opening and closing travel of the valve and limits the torque and thrust loads with its torque limit switch. As a result, all valve operating parts are protected from overload, improper seating and foreign obstructions.

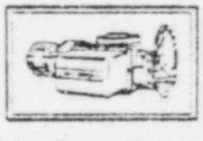
Limitorque controllers may be mounted on any size valve in almost any position or location. Readily adaptable to existing equipment, Limitorque can be actuated by electricity, hydraulic pressure, air or natural gas.

Where to Find Information

LIMITORQUE
TYPE SMC-04 AND SMC-03
INSTRUCTION AND MAINTENANCE MANUAL

A PRODUCT OF LIMITORQUE® CORPORATION

LIMITORQUE CORPORATION



5114 Woodall Road Lynchburg, Virginia 24502 • Telephone: 804/528-4400 • Telex: 82-9448

Limitorque B.V.
P.O. Box 155
Cuyk (N.B.), The Netherlands
Telephone: 31-8850-15744
Telex: 37279

Limitorque/Nippon Gear Co., Ltd.
7, Kirihara-Cho
Fujisawa Kanagawa-Ken, Japan
Telephone: 0466-44-3211
Telex: 3862-261

Offices and Representatives in major cities around the world
Directory available upon request.

Printed in USA

WP-5M 1/81

■ When mounted on new valves, Limitorque operators are normally furnished by the valve manufacturer. In this way the user may be assured of a "package" unit of valve and valve operator properly mounted and tested.

Selecting the proper size Limitorque should be done either by our sales engineers or the valve manufacturer and thus the user will have the advantage of the most economical control for each application.

Existing hand operated valves may be motorized in most cases by merely replacing the valve yoke with a yoke adapter for mounting the Limitorque control.

Whether ordering a new Limitorque equipped valve or modernizing an existing one, the following information should be included.

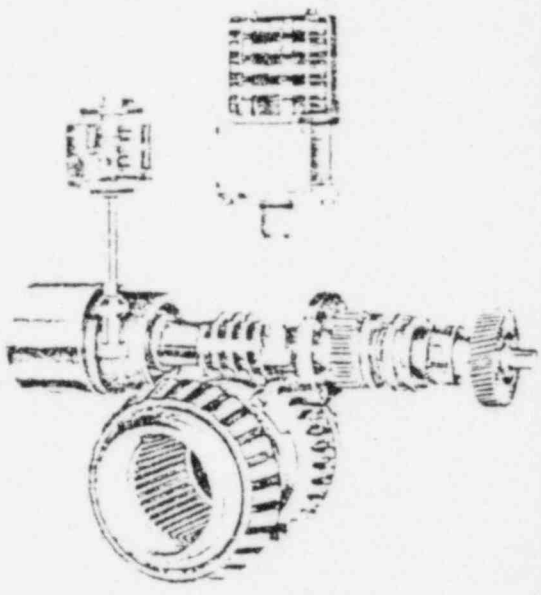
1. Valve size—type and make.
2. Maximum differential pressure.
3. Stem diameter—pitch and lead—hand of threads.
4. Desired closing or opening time in seconds.
5. Turns of yoke nut to open valve.
6. Voltage, phases, cycles (or D.C.)
7. Maximum temperature of fluid and ambient temperature at each valve location.
8. Type and frequency of service—regulating or intermittent.
9. Class desired—weather proof or explosion proof.
10. Type of contactor panel enclosure.
11. Type of control station enclosure.
12. Control voltage.

■ To produce a motorized valve control with the highest possible torque and thrust capacities, only the most highly efficient and precision gearing is utilized.

The helical gear and pinion form the first reduction from the motor. These gears are of heat treated alloy steel with teeth hobbed and finish shaved for accuracy.

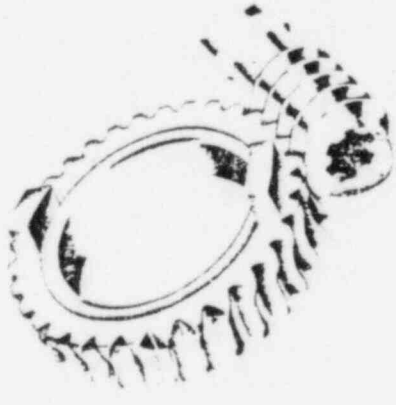
The worm and worm gear make up the second reduction and final drive to the threaded valve unit. The worm is of alloy steel with threads carburized, hardened and ground for high efficiency and long life. The worm gear is machined from a high tensile strength bronze and teeth are hobbed for smooth operation and long life. All Limitorque gearing is liberally proportioned for a 100% overload condition.

The Limitorque worm gear drives the valve nut assembly through two sturdy lugs. This type of construction produces a "Hammer Blow" effect which allows the motor and gearing to pick up full speed and momentum before torque is applied to the valve stem nut. This feature many times increases the effectiveness of Limitorque in unseating even the stickiest of valves. Also in the larger controls this same "Hammer Blow" feature is applied to the handwheel, thus practically eliminating the possibility of valve disc becoming frozen in its seat in the event of power failure.

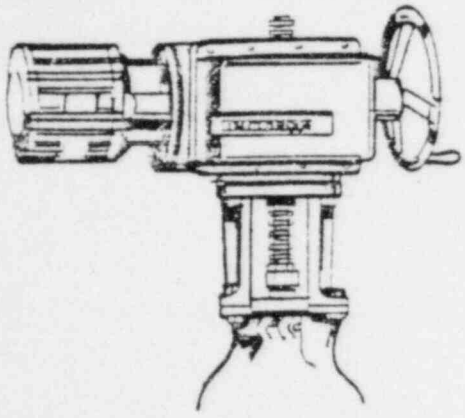


Internal assembly showing position of Limit Switches

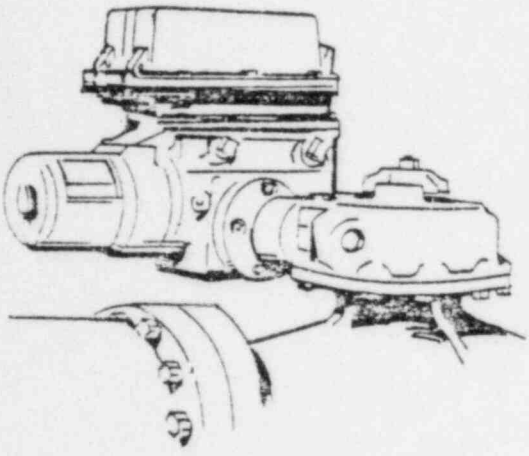
Helical Gear Set



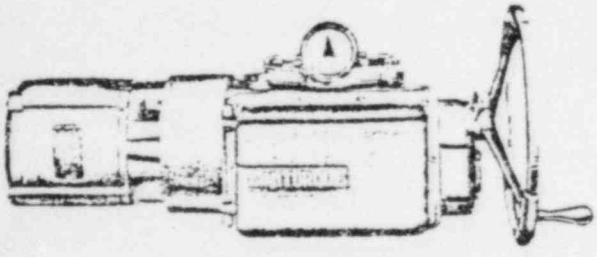
Worm Gear Set



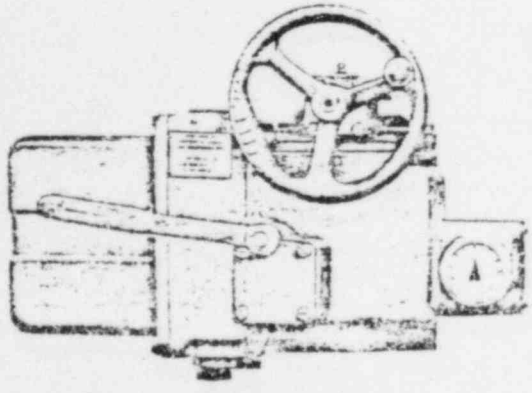
Gate Valve (Top Mounted)
Fig. 1



Gate Valve (Side Mounted)
Fig. 2



Position Indicator for
SMB-0 through SMB-5



Position Indicator for
SMB-000 and SMB-00

■ Although it is possible to mount Limitorque Valve Controls in any position, the preferred mounting arrangement is as shown in Fig. 1 and 2 with the motor horizontal and the Limit Switch compartment horizontal or vertical up. If it is necessary to mount in other positions than those shown, mounting position should be stipulated at time of order.

There are a number of reasons why these mounting positions are preferred, the most important being assurance of proper distribution of lubricants through internal working components of the unit. With the Limitorque unit mounted so that motor shaft and handwheel shaft are horizontal, the grease covers all high speed gearing as well as the low speed gears.

With the limit switch compartment in vertical up position, lubricant covers the internal portion of the limit switches while protecting against an unduly high head of grease acting on the shafts and mounting flanges of the geared limit switch and torque switch (which are located in the limit switch compartment).

Since the main housing of the unit is not completely filled with grease due to the creating of internal pressures, it is necessary to specify, at time of ordering, when the unit is to be mounted with motor vertically up. In cases of this kind, additional grease is added during assembly of unit to insure complete coverage of the high speed motor gears.

■ The mechanical dial position indicator (photographs shown to the left) shows local valve position on a dial graduated in percent of valve opening; however, special dials can be provided if required.

Remote valve position indication can be obtained using a slide wire receiver and transmitter.

1. When unit is placed in handwheel operation all that is necessary to obtain motor operation is to energize motor. Unit will then automatically, mechanically shift to motor operation.

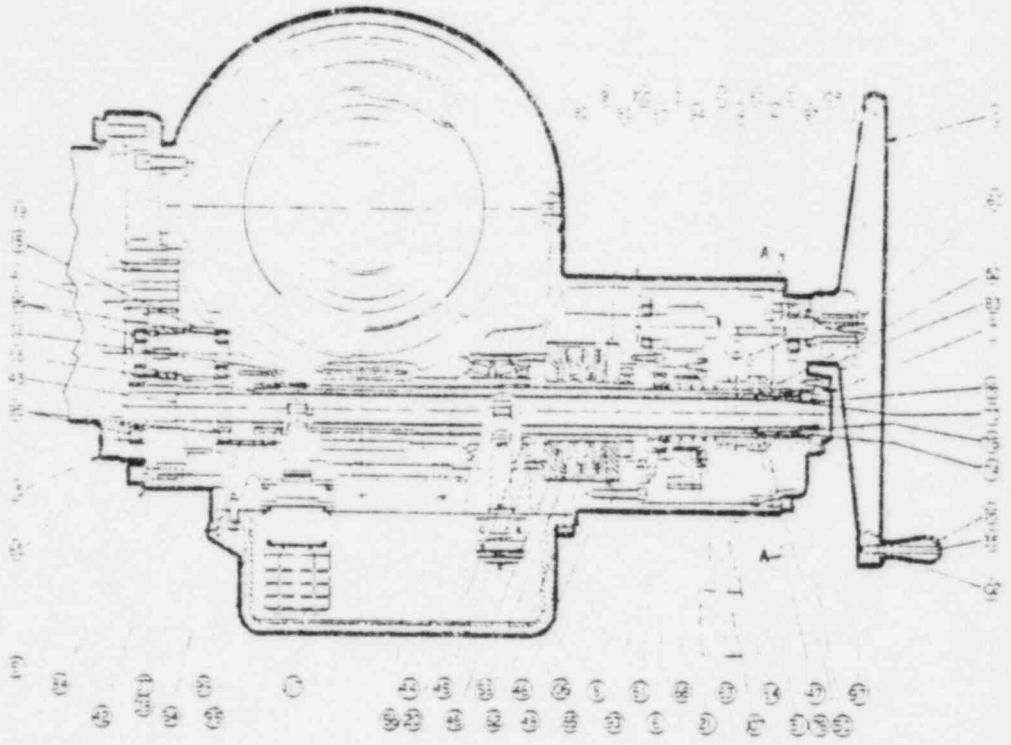
   DO NOT LIFT UP ON DECLUTCH LEVER.

2. After Limitorque unit is electrically connected, operate by hand to place the valve at some intermediate position. CHECK FOR CORRECT POLARITY of the unit by energizing the open circuit. If the motor opens the valve, polarity is correct. If the motor should close the valve, deenergize the circuit immediately and reverse any two leads of the three phase motor or if D.C. reverse the A1 and A2 connections.

3. Make sure power to Limitorque is turned off before any adjustments to limit switches are made.

4. Make sure limit switches are set properly before allowing unit to seat valve in either direction. See instruction book furnished with Limitorque unit.

P.C. NO.	DESCRIPTION
67	TRIPPER SPRING
68	CLUTCH COMPRESSION SPRING
69	DECLUTCH SHAFT SPACER
70	DECLUTCH SHAFT WASHER
71	DECLUTCH LEVER NAME PLATE
72	STOP STUD
73	FLEXIBLE JAW CLUTCH SLEEVE
74	FLEXIBLE JAW CLUTCH COLLAR
75	NYLON INSERT
76	INTERNAL SPACER
79	HOUSING COVER GASKET
80	DECLUTCH HOUSING GASKET
81	DECLUTCH CAP GASKET
82	DECLUTCH COVER GASKET
83	WORM SHAFT END CAP GASKET
84	MOTOR ADAPTER GASKET
85	GASKET MOTOR
86	LIMIT SWITCH COVER GASKET
90	BEARING CONE
91	BEARING CUP
92	BEARING SPACER
93	BEARING
94	HANDWHEEL SHAFT BEARING
95	BEARING
96	BEARING
97	BEARING
98	BEARING LOCKNUT
99	BEARING LOCKNUT
100	BEARING LOCKNUT W/CUP PT.
101	ROLL PIN $\frac{1}{16}$" X $1\frac{1}{2}$"
102	RETAINING RING
103	HALLOWELL COLLAR .75" BORE
104	QUAD RING
105	OIL SEAL
106	SPIROLOX RING
107	SPIROLOX RING
108	OIL SEAL
109	GROOVE PIN
110	ROLL PIN
111	GREASE FITTING
112	WELSH PLUG
115	MOTOR
116	TORQUE SWITCH
117	GEAR LIMIT SWITCH
124	HOUSING COVER
125	HOUSING THRUST ADAPTER
126	THRUST DRIVE SLEEVE
127	STEM NUT
128	THRUST BEARING CARTRIDGE
129	SEAL RETAINER PLATE
130	DRIVE SLEEVE LOCKNUT
131	THRUST BEARING
132	OIL SEAL
133	GREASE FITTING
134	"O" RING
135	GASKET
136	GASKET
137	THREADED FLANGE
138	DYNA-SEAL WASHER



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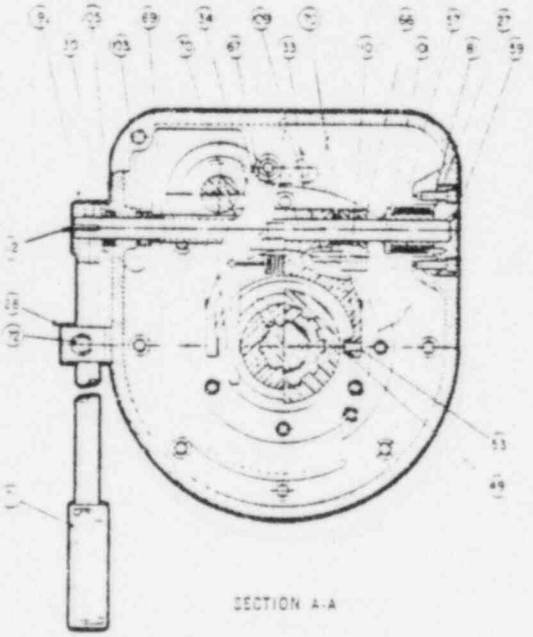
SMB-5 AND 5T



SECTION A-A

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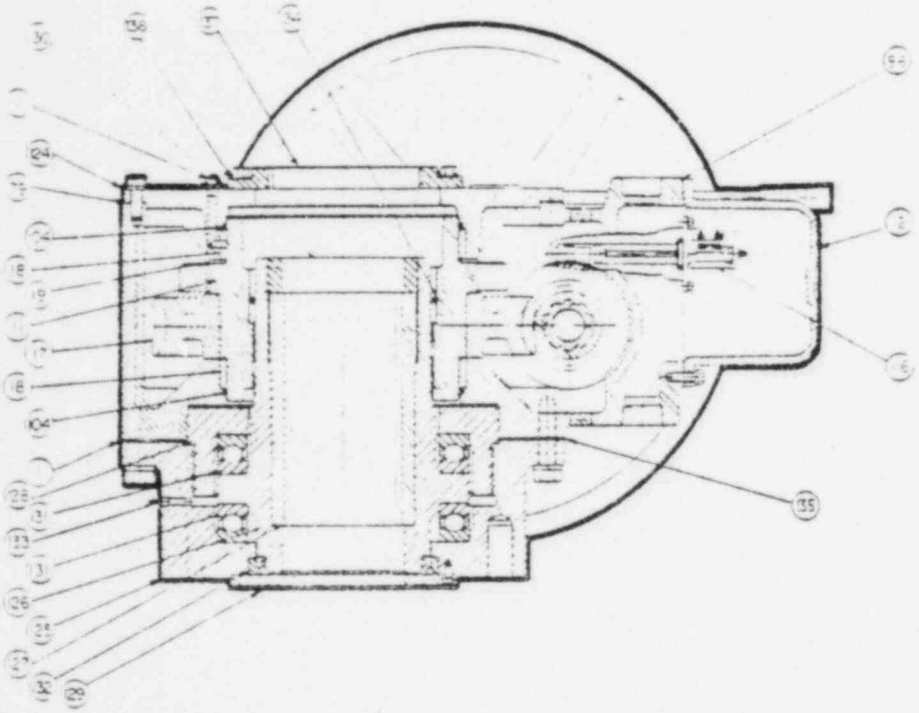
SMB-5



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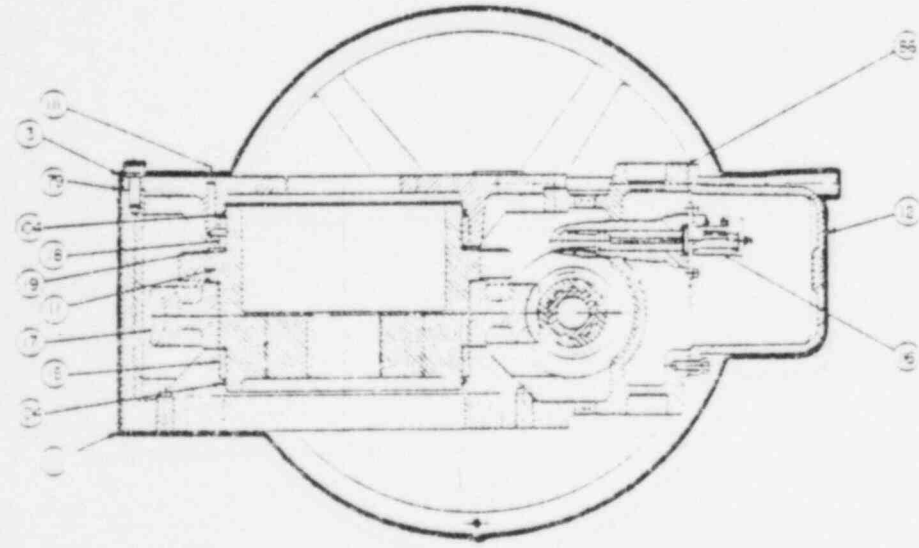
CROSS SECTION OF DRIVE SLEEVE—THRUST UNIT

P.C. NO.	DESCRIPTION
1	HOUSING
2	DECLUTCH HOUSING
3	HOUSING COVER
4	DECLUTCH HOUSING COVER
5	MOTOR ADAPTER
6	HANDWHEEL GEAR
7	WORM SHAFT END CAP
8	GEAR MOUNTING BRACKET
9	DECLUTCH LEVER
10	HANDWHEEL 30"
11	TORQUE DRIVE SLEEVE
12	LIMIT SW. COMPARTMENT COVER
13	HANDWHEEL CLUTCH
14	FORK
15	INTERMEDIATE PINION AND SHAFT
17	WORM GEAR
18	DRIVE SLEEVE BUSHING
19	DRIVE SLEEVE THRUST BEARING
20	WORM BUSHING
21	BUSHING—HANDWHEEL GEAR
27	DECLUTCH LEVER DRUM
28	DECLUTCH LEVER STOP
30	DECLUTCH SHAFT
31	TRIPPER BOLT
32	G.L. THREADED COLLAR
33	CLUTCH TRIPPER #1
34	CLUTCH TRIPPER #2
35	HANDLE ROD
36	HANDLE CHROME PLATED
37	HINGE—UPPER
38	HINGE—LOWER
39	MOTOR PINION
40	HANDWHEEL SHAFT & PINION
41	MOTOR DRIVE INTERMEDIATE GEAR
42	DRIVE SHAFT GEAR
43	DRIVE SHAFT (SOLID
44	BEARING CARTRIDGE CAP
45	BEARING CARTRIDGE STEM
46	THRUST WASHER
47	GEAR CLUTCH SPACER
48	NUT—CARTRIDGE STEM
49	FORK—ROLLER
50	FLEXIBLE JAW CLUTCH HOUSING
51	SLIDING GEAR CLUTCH
52	MOTOR CLUTCH GEAR CAM PIN
53	PIN FORK ROLLER
54	SPLINED INSERT
55	HOLLOW DRIVE SHAFT
56	WORM
57	TORSION SPRING
58	BELLEVILLE SPRING
59	DECLUTCH CAP
60	WASHER—HANDWHEEL
61	SPRING WASHER
62	TORQUE LIMIT SLEEVE
63	HANDWHEEL GEAR SPACER
64	BEARING SPACER
65	BEARING ADAPTER
66	DECLUTCH ARM

SMB-5T



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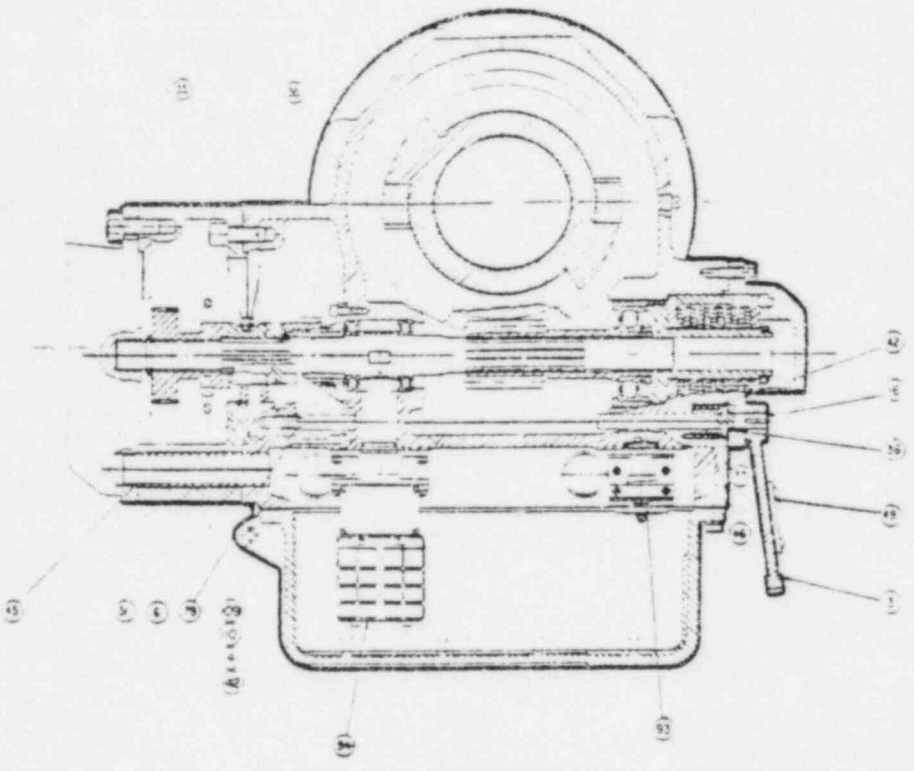
CROSS SECTION OF DRIVE SLEEVE—TORQUE UNIT

LIST

P.C. NO.	DESCRIPTION
72	HANDWHEEL SHAFT NEEDLE BEARING
76	ELASTIC STOP NUT
77	ROLL PIN
78	RETAINING RING
79	RETAINING RING
82	RETAINING RING
83	RETAINING RING
84	RETAINING RING
85	BELLEVILLE SPRINGS
86	"O" RING
87	OIL SEAL
88	MOTOR BUSHING
92	MOTOR ASSEMBLY
93	TORQUE SWITCH ASSEMBLY
94	GEAR LIMIT SWITCH ASSEMBLY
100	HOUSING
101	HOUSING COVER
102	LIMIT SW. COMPARTMENT COVER
103	DRIVE SLEEVE
106	SPACER WORM GEAR
107	LOCKNUT
108	RETAINING PLATE
109	HINGE
110	HINGE
113	WORM GEAR
114	STEM NUT
115	BEARING SHIM
118	GASKET
119	GASKET
122	ROLLER BEARING CUP
123	ROLLER BEARING CONE
124	ROLLER BEARING CONE
125	GREASE FITTING
126	VENT PLUG ⅛ N.P.T.
127	VENT PLUG ⅜ N.P.T.
128	QUAD RING
129	QUAD RING
135	HOUSING
136	HOUSING COVER
137	DRIVE SLEEVE
138	LIMIT SW. COMPARTMENT COVER
140	SPLINE ADAPTER
141	HINGE
142	HINGE
143	WORM GEAR
144	BUSHING
145	BUSHING
148	GASKET
149	GASKET
152	QUAD RING
153	QUAD RING
154	GREASE FITTING
155	VENT PLUG



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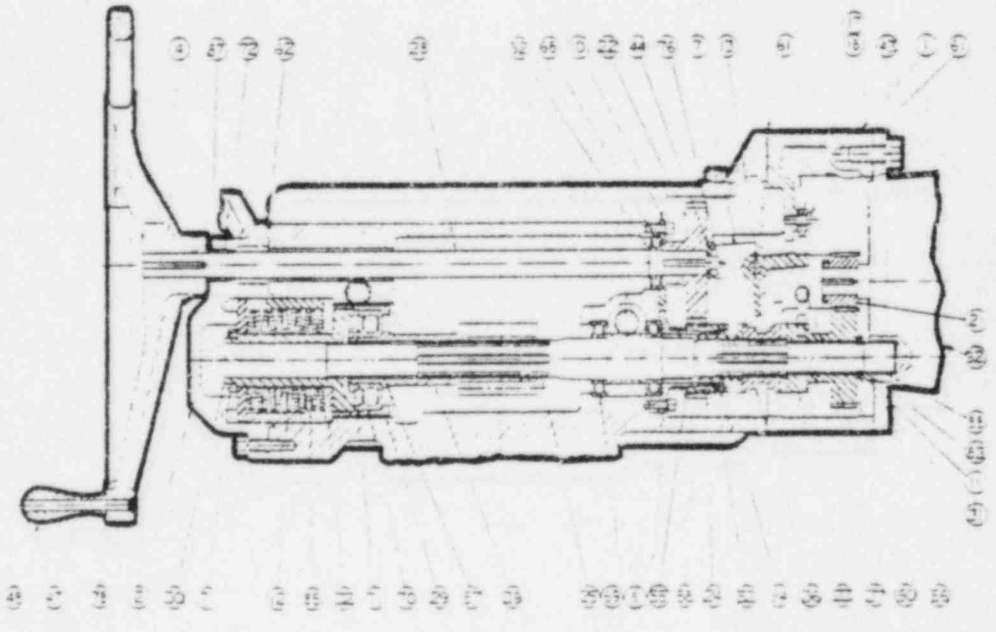

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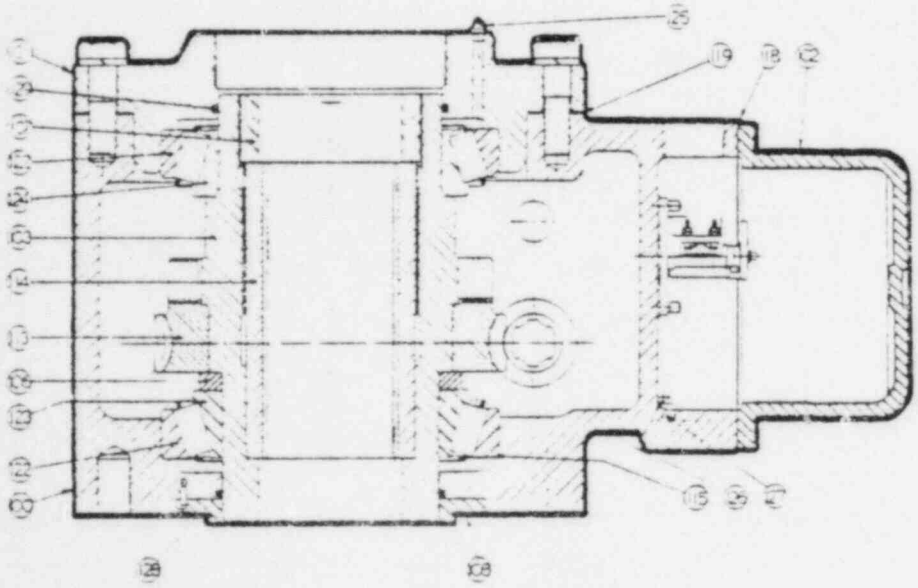

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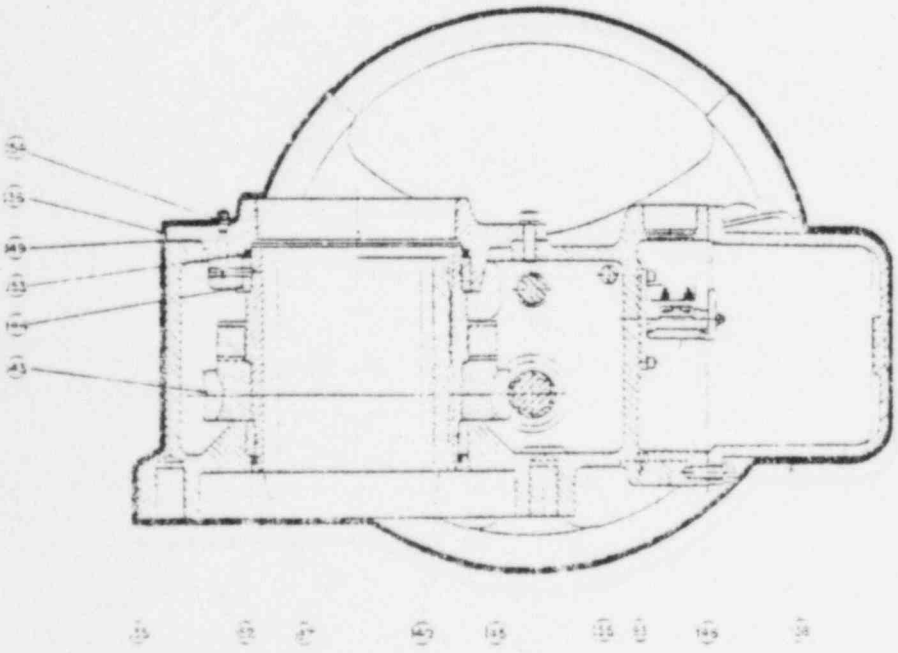
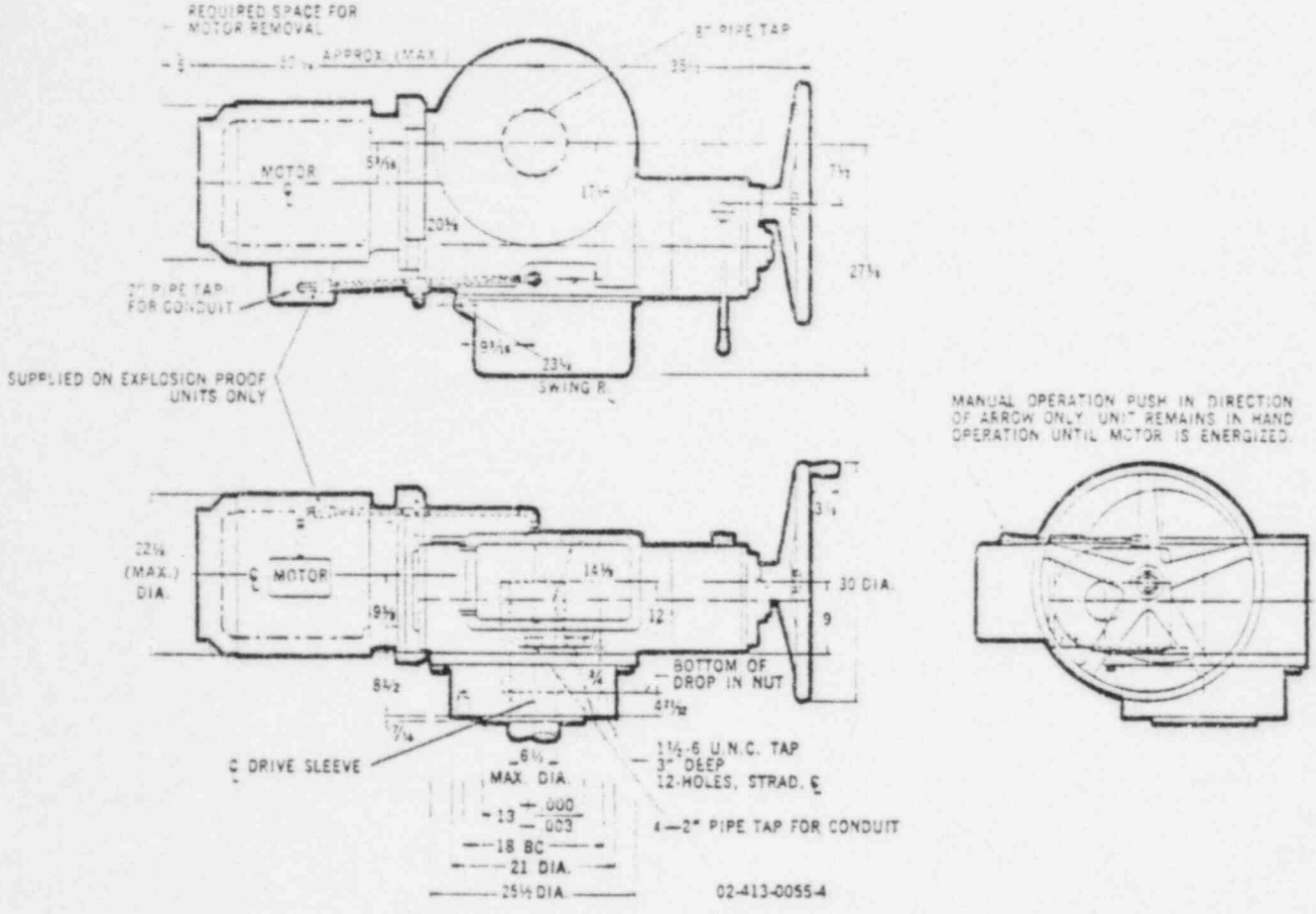
CROSS SECTION OF DRIVE SLEEVE—THRUST UNIT



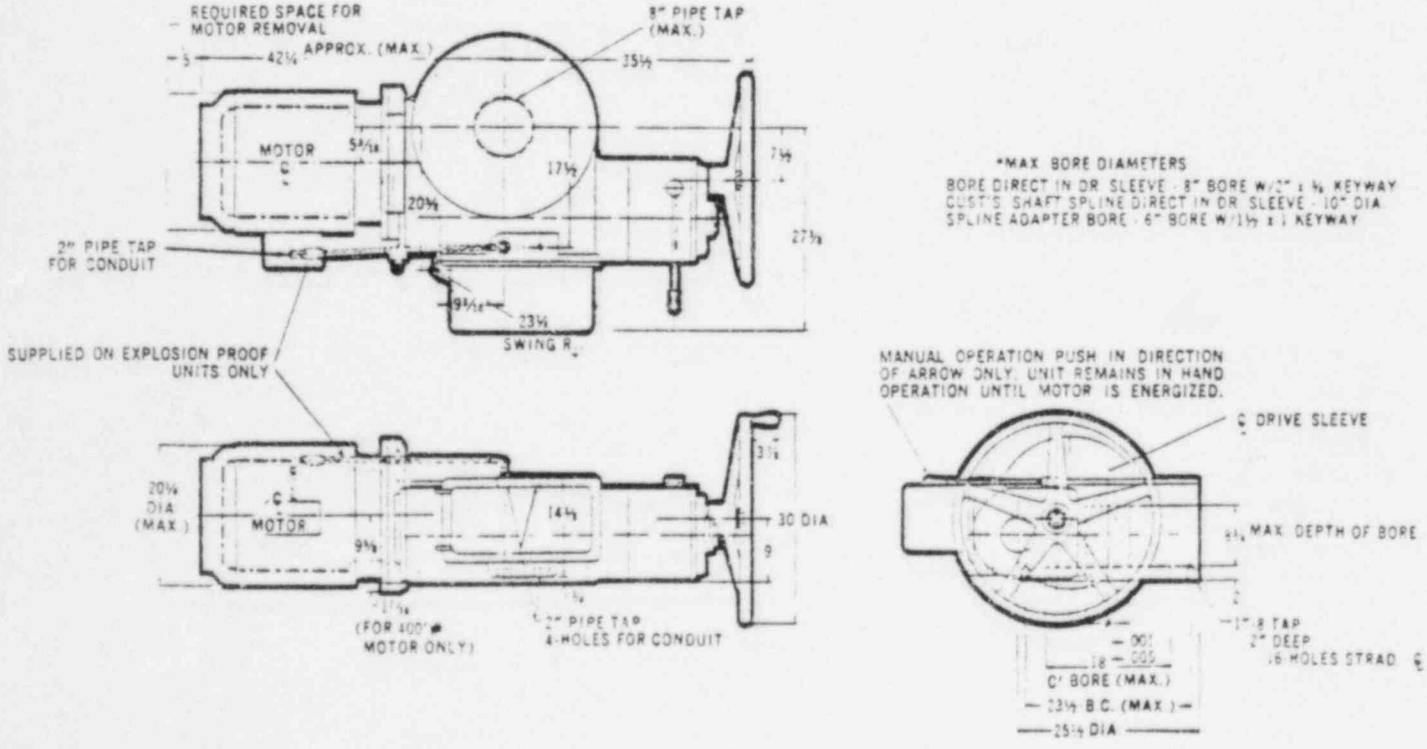
01-413-0039-4

CROSS SECTION OF DRIVE SLEEVE—TORQUE UNIT

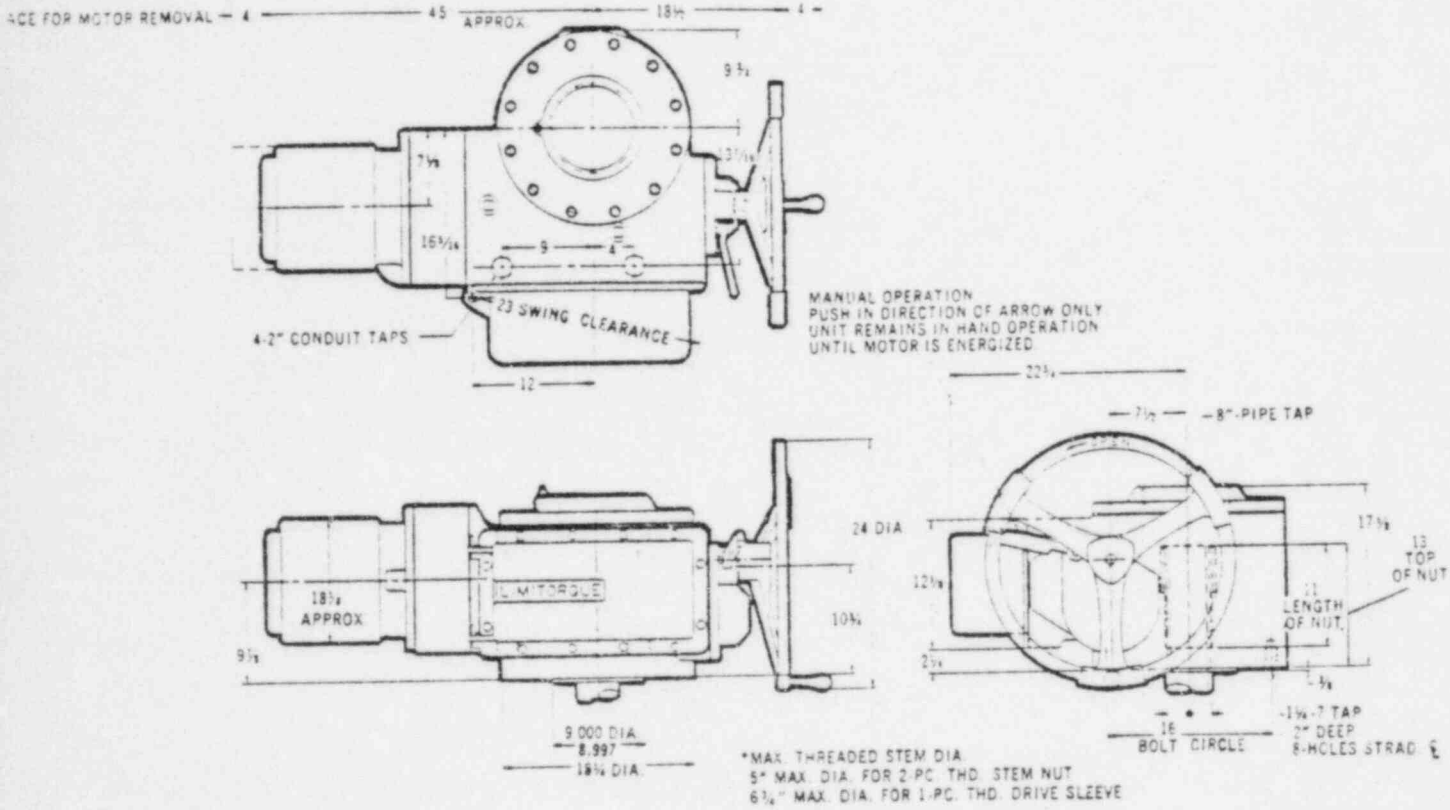
PC. NO.	DESCRIPTION
1	CLUTCH HOUSING
2	SPRING CARTRIDGE CAP
3	DECLUTCH LEVER
4	HANDWHEEL 24"
5	WORM SHAFT BEARING CAP
6	DECLUTCH ARM
7	DECLUTCH FORK
10	HANDWHEEL BEARING CAP
11	WORM SHAFT SPLIT RING RETAINER
12	TORQUE LIMIT SLEEVE
13	FORK PIVOT PIN
16	MANUAL DECLUTCH SHAFT
17	CLUTCH TRIPPER #1
18	CLUTCH TRIPPER #2
21	MOTOR PINION
22	HANDWHEEL SPUR GEAR
23	MOTOR CLUTCH GEAR
24	HANDWHEEL CLUTCH PINION
25	WORM SHAFT
28	HANDWHEEL SHAFT
29	BEARING CARTRIDGE CAP
30	BEARING CARTRIDGE STEM
31	WORM SHAFT SPLIT RING
32	THRUST WASHER
35	FORK ROLLER
36	WORM SHAFT CLUTCH
37	TRIPPER CAM PIN
38	FORK ROLLER PIN
39	WORM
42	DECLUTCH SHAFT TORSION SPRING
43	TRIPPER BOLT
44	HANDWHEEL SHAFT FLAT WASHER
45	MOTOR CONDUIT NIPPLE
46	DECLUTCH SHAFT DRUM
47	HANDLE ROD
48	HANDLE CHROME PLATE
49	DECLUTCH NAME PLATE
50	TRIPPER SPRING
51	FORK SPACER
52	CLUTCH COMPRESSION SPRING
55	SPRING RING
56	WORM SHAFT GEAR BUSHING
57	WORM BUSHING
58	HANDWHEEL PINION SPRING
61	GASKET (MOTOR CLUTCH HOUSING AND MOTOR)
62	SPRING CARTRIDGE CAP GASKET
68	HANDWHEEL SHAFT BALL BEARING
69	WORM SHAFT BALL BEARING
70	WORM BALL BEARING
71	WORM AND CARTRIDGE LOCKNUT



FOR INSTALLATION PURPOSES USE CERTIFIED DIMENSIONS ONLY.



FOR INSTALLATION PURPOSES USE CERTIFIED DIMENSIONS ONLY.



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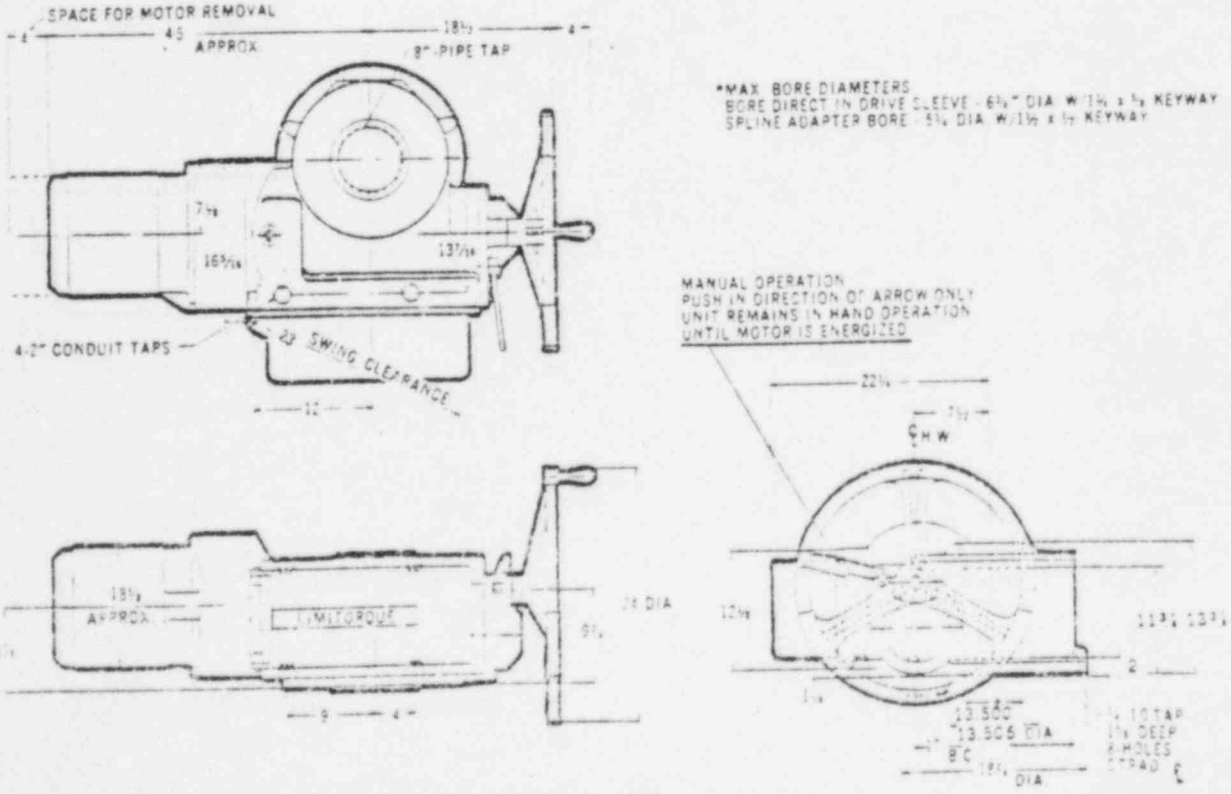
FOR INSTALLATION PURPOSES USE CERTIFIED DIMENSIONS ONLY.



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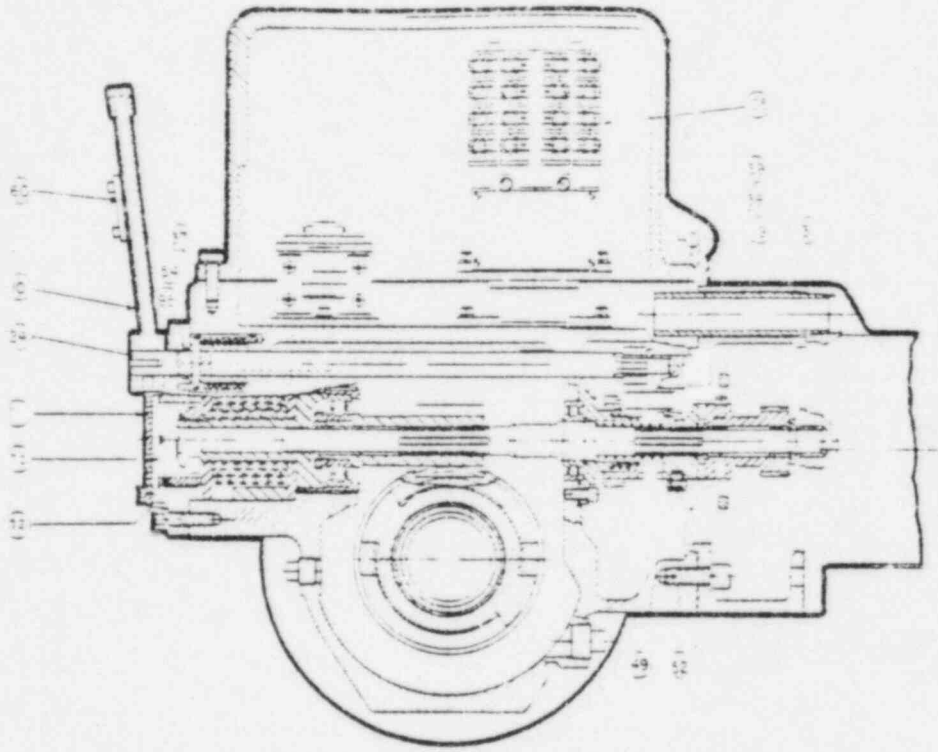
FOR INSTALLATION PURPOSES USE CERTIFIED DIMENSIONS ONLY.

PC. NO.	DESCRIPTION
37	DRUM
38	UPPER HINGE
39	LOWER HINGE
40	MOTOR PINION
41	W. S. CLUTCH GEAR
42	H. W. CLUTCH PINION
43	WORM SHAFT
44	BEARING CARTRIDGE CAP
45	BEARING CARTRIDGE STEM
46	SPACER
47	SPLIT RING
48	THRUST WASHER
49	CLUTCH ROLLER
50	W. S. CLUTCH
51	TRIPPER PIN
52	CLUTCH ROLLER PIN
53	WORM
54	TORSION SPRING
55	"O" RING SPACER
56	BELLEVILLE SPRING
57	H. W. PINION SPRING
58	FORK RETURN SPRING
59	TRIPPER SPRING
60	NAMEPLATE
66	HOUSING COVER GASKET
67	CLUTCH HSG. & MOTOR GASKET
68	SPRING CART. CAP GASKET
69	L. S. COMP. COVER GASKET
70	LOCKNUT
71	SPRING CART. CAP PLATE
72	SPRING CART. CAP PLATE GASKET
74	BEARING SHIMS
75	ROLLER BEARING CONE
76	ROLLER BEARING CUP
77	ROLLER BEARING CONE
78	ROLLER BEARING CUP
79	BALL BEARING
80	BALL BEARING
81	BALL BEARING
82	BALL BEARING
83	BEARING LOCKNUT
84	ELASTIC STOP NUT
85	ELASTIC STOP NUT
86	RETAINING RING
87	RETAINING RING
88	RETAINING RING
89	RETAINING RING
90	RETAINING RING
91	RETAINING RING
92	RETAINING RING
93	QUAD RING
94	QUAD RING
95	"O" RING
96	"O" RING
97	BUSHING
98	GREASE FITTING
103	MOTOR
104	TORQUE SWITCH
105	GEARED LIMIT SWITCH



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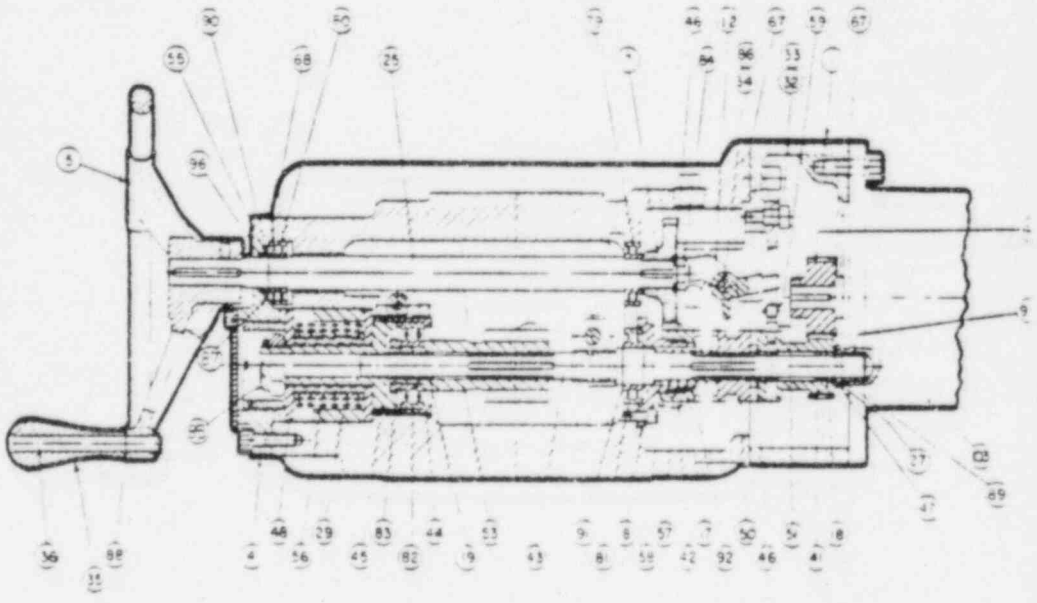

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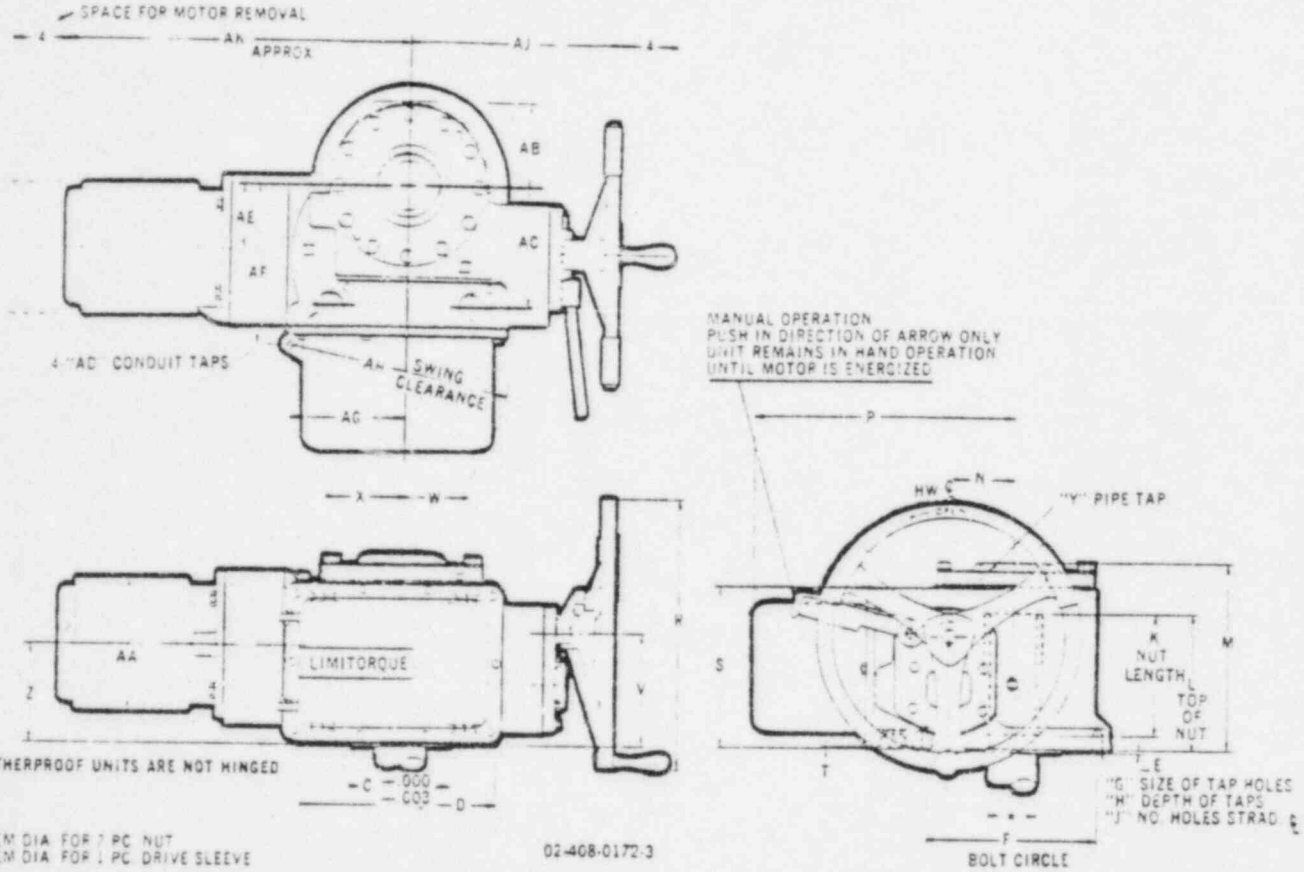
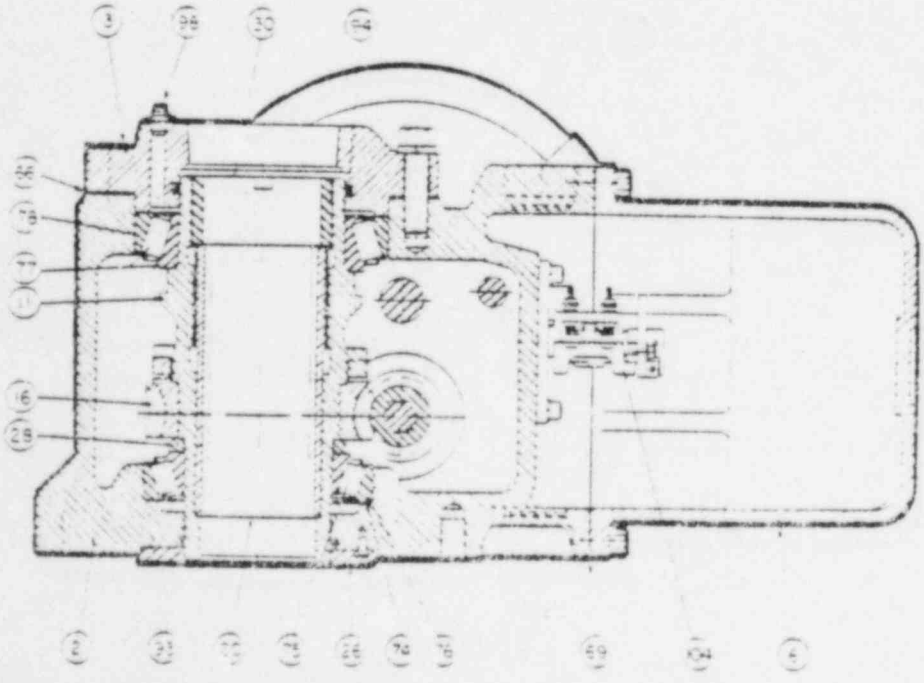


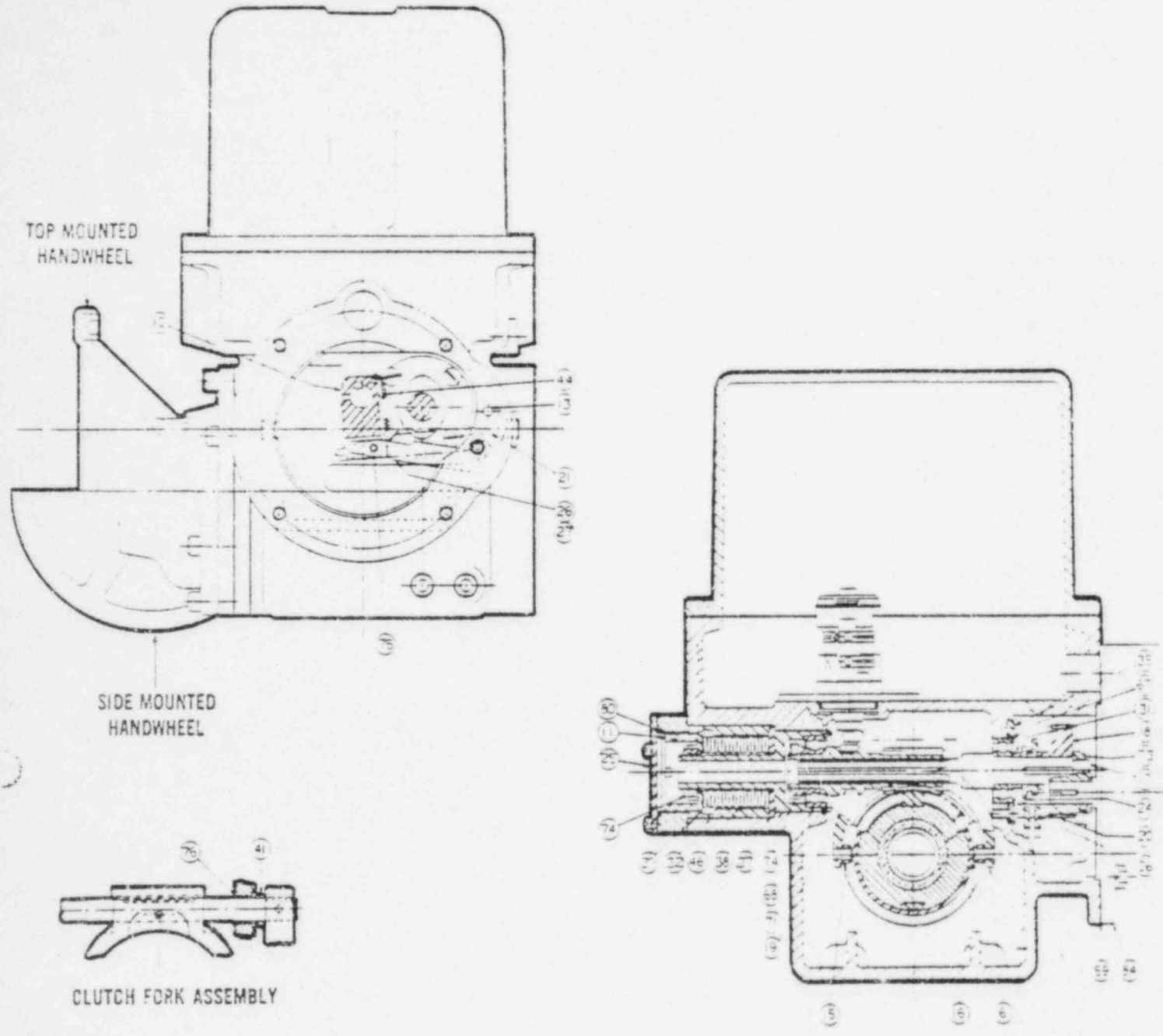
UNIT SIZE	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AJ	AK
SMB-0	2 1/8	2 3/4	.5	8 1/4	4 3/16	6 1/2	1/2-10	1	4	6 1/16	7 7/16	10 7/16	3	15 11/16	12	10 3/4	1/16	6 7/16	5 11/16	4 3/16	3	5 11/16	10 1/2	4 1/8	6 1/4	1 1/2	3	8 13/16	6 1/4	15 1/2	13 1/8	24
SMB-1	2 7/8	3 1/4	.16	11 1/8	5 3/16	10	5/8-11	1	8	7	8	11 5/8	3 1/8	16 13/16	12	10 3/4	1/16	6 1/8	4 13/16	4 13/16	3 1/2	5 1/8	12	4 11/16	7 1/8	1 1/2	3 1/4	9 13/16	7 1/16	15 1/2	12 3/4	26
SMB-2	3 1/2	3 3/4	.7	13 1/2	7 3/16	12 3/4	3/4-10	1 1/4	8	8 1/4	9 1/4	13	4 1/2	17 1/8	18	10 13/16	1/4	7 7/16	5 1/2	5 1/32	5	6 1/8	14	5 3/8	8 3/16	1 1/2	4 3/8	10 1/8	7 3/16	15 1/2	14 1/2	32 1/2
SMB-3	5	5 1/4	8 1/2	.16	7 7/16	14	.x.9	1 1/4	8	9 1/8	10 1/8	14 1/16	6	20 1/16	24	12 1/2	1/4	9 1/8	4	9	5	8 1/2	16	8	11 1/4	1 1/2	5 1/8	13 5/16	12 1/8	23 1/8	17 3/4	39 1/2

FOR INSTALLATION PURPOSES USE CERTIFIED DIMENSIONS ONLY.

PARTS LIST

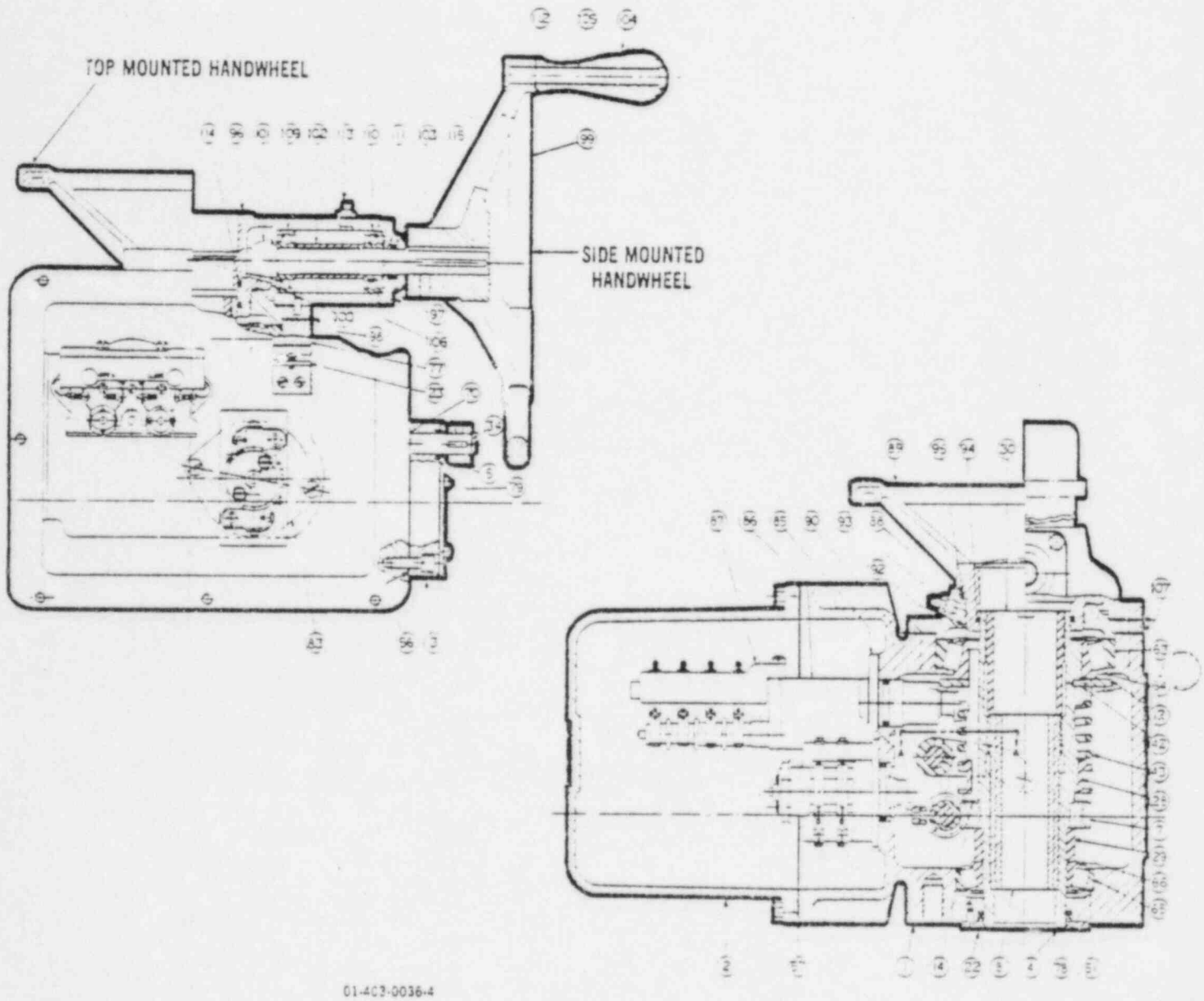


PC. NO.	DESCRIPTION
1	CLUTCH HOUSING
2	HOUSING
3	HOUSING COVER
4	SPRING CARTRIDGE CAP
5	HANDWHEEL 12"
6	LIMIT SW. COMP. COVER
7	HANDWHEEL GEAR
8	WORM SHAFT BEARING CAP
9	DECLUTCH LINK
10	DECLUTCH LEVER
11	DRIVE SLEEVE
12	DECLUTCH FORK
16	WORM GEAR
17	SPRING RING
18	BUSHING
19	BUSHING
20	STEM NUT
24	MANUAL DECLUTCH SHAFT
25	HANDWHEEL SHAFT
26	SEAL RETAINER PLATE
27	SPLIT RING RETAINER
28	WORM GEAR SPACER
29	TORQUE LIMIT SLEEVE
30	LOCKING NUT
31	MOTOR CONDUIT NIPPLE
32	CLUTCH TRIPPER #1
33	CLUTCH TRIPPER #2
34	FORK PIVOT PIN
35	HANDLE
36	HANDLE ROD



01-403-0035-4

PC. NO.	DESCRIPTION	PC. NO.	DESCRIPTION	PC. NO.	DESCRIPTION
65	ROLLER BEARING CUP	85	G. L. SW. CART. ASS'Y	100	BEVEL GEAR
66	ROLLER BEARING CONE	86	G. L. GEAR BOX SUB-ASS'Y	101	HANDWHEEL BEVEL PINION
67	BALL BEARING	87	G. L. SW. PANEL SUB-ASS'Y	102	BEARING SPACER
68	BALL BEARING		PARTS FOR TOP MOUNTED HANDWHEEL	103	"O" RING SPACER
70	RETAINING RING	88	HOUSING COVER	104	HANDLE
71	RETAINING RING	89	HANDWHEEL	105	HANDLE ROD
73	LOCKNUT	90	HOUSING COVER GASKET	106	GASKET
74	LOCKNUT	92	RETAINING RING	107	GASKET
75	SPRING PIN	93	GREASE FITTING	109	BALL BEARING
76	BUSHING	94	QUAD RING	110	BALL BEARING
77	MOTOR TERMINAL BLOCK	95	"O" RING	111	RETAINING RING
78	QUAD RING		PARTS FOR SIDE MOUNTED HANDWHEEL	112	RETAINING RING
79	QUAD RING	96	BEVEL GEAR HOUSING	113	GREASE FITTING
80	"O" RING	97	BEVEL PINION CAP	114	QUAD RING
83	TORQUE SWITCH ASS'Y	98	BEVEL GEAR CARTRIDGE	115	"O" RING
84	MOTOR ASS'Y	99	HANDWHEEL		

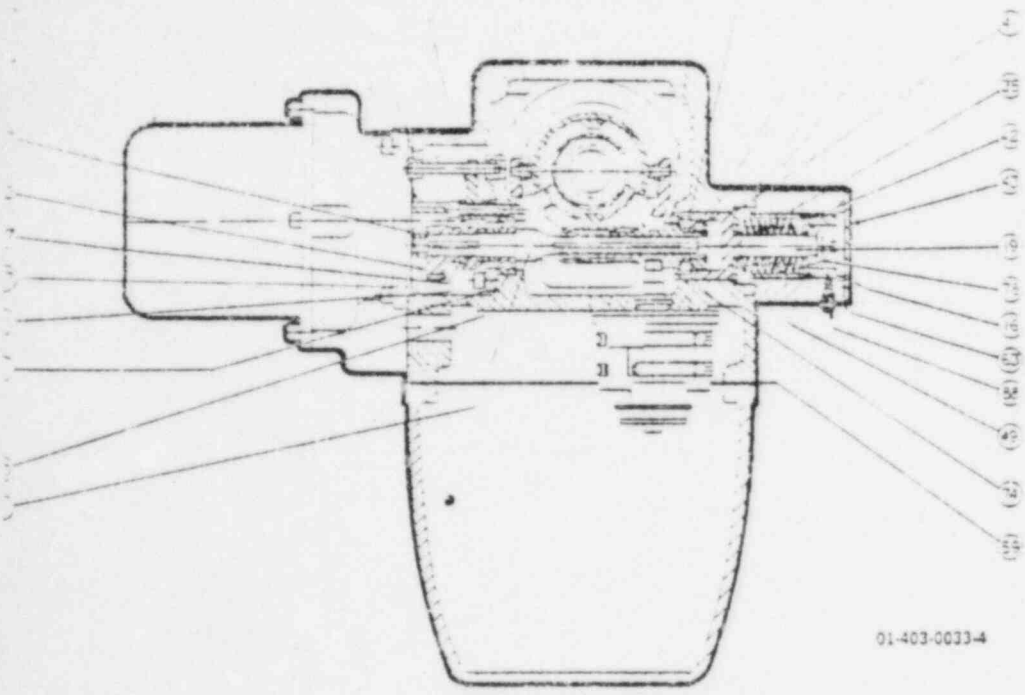


01-403-0036-4

PC. NO.	DESCRIPTION	PC. NO.	DESCRIPTION	PC. NO.	DESCRIPTION
1	HOUSING	18	WORM SHAFT GEAR	35	WORM SHAFT BEARING CAP
2	LIMIT SWITCH COMPART COVER	19	WORM	36	CAM SPACER
3	SPRING CARTR OBE CAP	20	MOTOR PINION	37	BEARING CARTRIDGE
4	DRIVE SLEEVE	21	TRIPPER ADJUST. ARM	38	THRUST WASHER
5	DECLUTCH LEVER	22	SEAL RETAINING PLATE	39	THRUST WASHER
6	DECLUTCH FORK	23	TERMINAL BRACKET	41	TRIPPER LEVER SPACER
7	WORM GEAR	24	TRIPPER CAM	42	DOWEL
8	STEM NUT	25	SPRING CART CAP COVER	43	CLUTCH RETURN SPRING
10	TRIPPER LEVER	26	TRIPPER #1	44	TRIPPER SPRING
11	LOCKNUT	27	TRIPPER #2	45	BELLEVILLE SPRINGS
12	R. H. DRIVE HYPOID GEAR	28	CLUTCH PIN	51	BEARING SHIMS
13	TRIPPER ADJUST. ARM PIN	29	WORM GEAR SPACER	54	GASKET
14	CLUTCH KEY	30	LOCKNUT	55	GASKET
15	CLUTCH ROLLER	31	BEARING SPACER	56	GASKET
16	CLUTCH ROLLER PIN	32	TORQUE LIMIT SLEEVE	60	ROLLER BEARING CUP
17	WORM SHAFT	34	DECLUTCH SHAFT	61	ROLLER BEARING CONE

SMB-000

PARTS LIST



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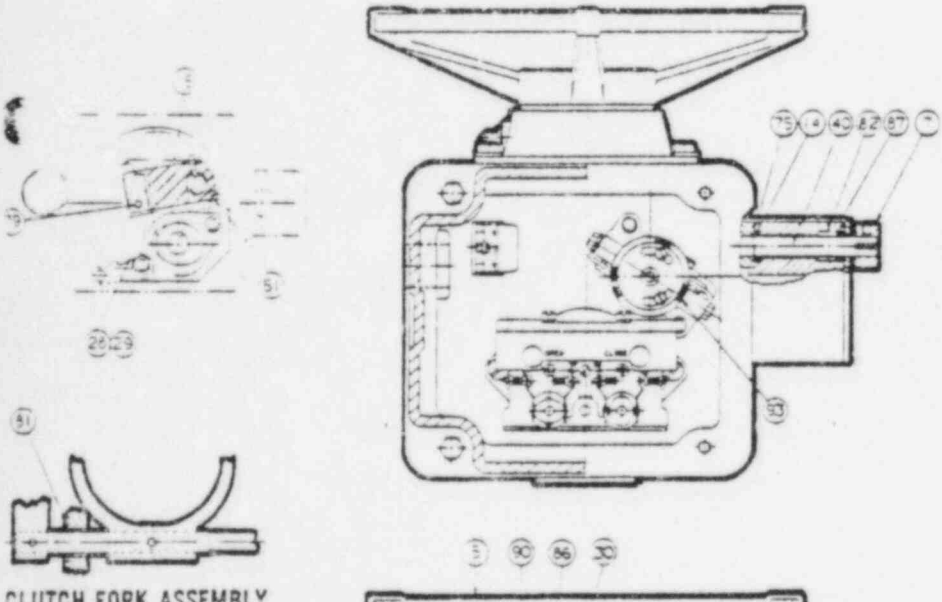
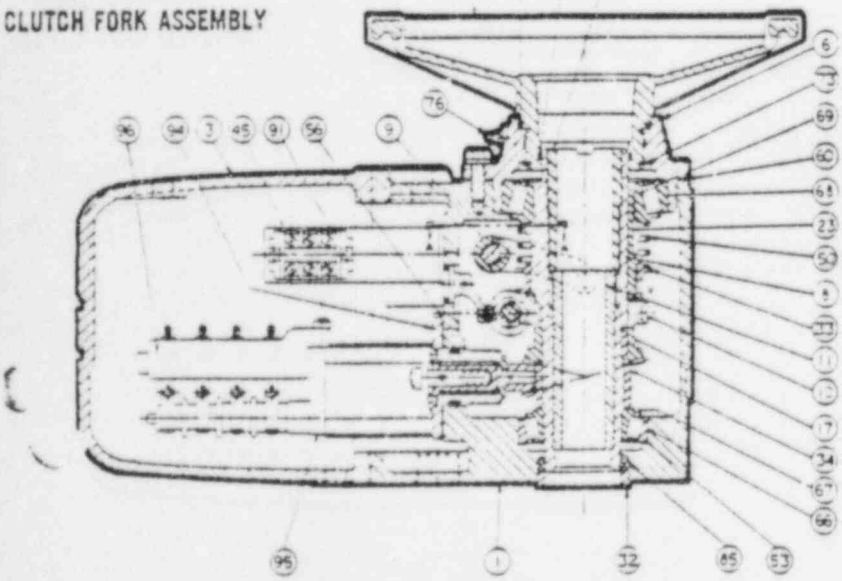


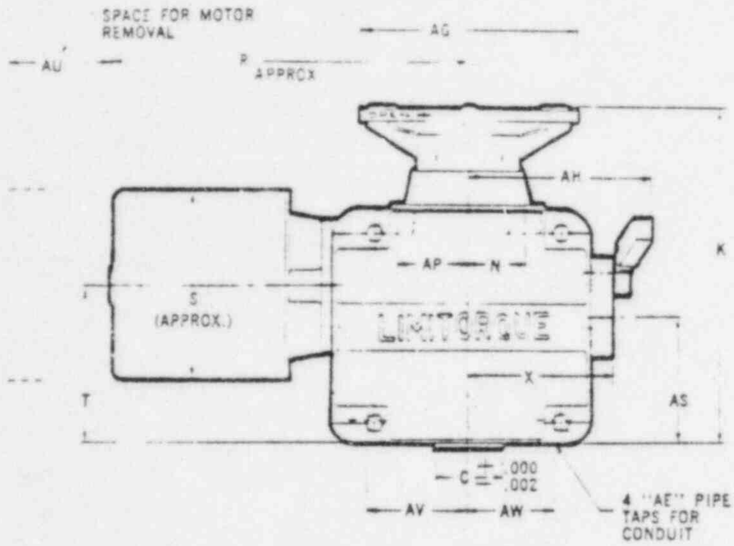
CLUTCH FORK ASSEMBLY

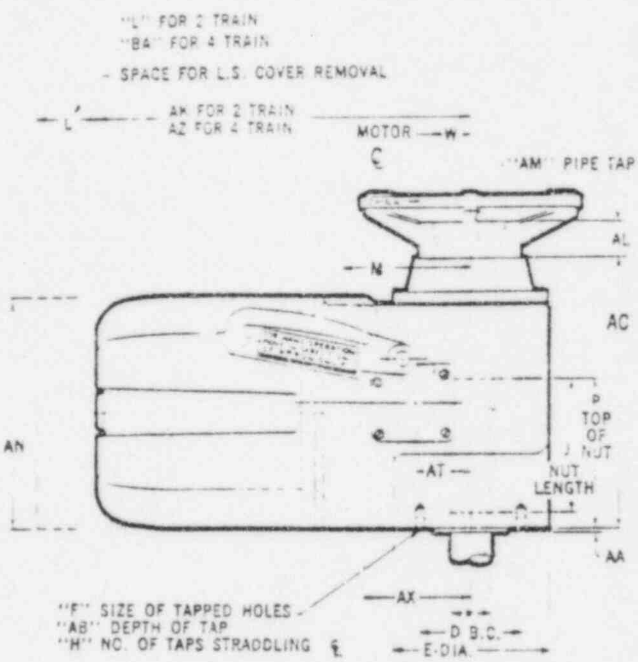


01-403-0034-4

PC. NO.	DESCRIPTION
1	HOUSING
2	SPRING CARTRIDGE CAP
3	LIMIT SW. COMPT. COVER
4	WORM SHAFT BEARING CAP
5	HANDWHEEL
6	HOUSING CAP
7	DECLUTCH LEVER
8	DRIVE SLEEVE
9	DECLUTCH FORK
10	WORM GEAR
11	STEM NUT
14	SPACER
15	TRIPPER LEVER
16	DECLUTCH SHAFT SPACER LOCKNUT
17	DRIVE SLEEVE BEVEL GEAR
19	BEARING CARTRIDGE
20	MOTOR PINION
21	WORM SHAFT
22	WORM SHAFT GEAR
23	CLUTCH KEY
24	WORM
25	CLUTCH ROLLER PIN
26	TRIPPER ADJUSTMENT ARM
27	TRIPPER CAM
28	TRIPPER #1
29	TRIPPER #2
30	LOCKNUT
31	CAM SPACER
32	SEAL CAP
33	CLUTCH RING
34	SPACER
35	SLEEVE TORQUE LIMIT
37	CAM SPACER
39	CLUTCH ROLLER
40	DECLUTCH SHAFT
41	THRUST WASHER
42	THRUST WASHER
43	SPRING CART. CAP COVER
44	WORM BEARING NUT
45	TERMINAL MTG. BRACKET
46	ADJUSTABLE ARM PIVOT PIN
49	BELLEVILLE SPRING
50	SPRING—CLUTCH COMP
51	SPRING TRIPPER
53	BEARING SHIM
56	SHIM G. L. SW. CART. ASS'Y
58	GASKET (MOTOR)
59	GASKET (L. S. COMPT.)
60	GASKET (HSG. CAP)
62	GASKET (SPRING CARTRIDGE)
63	GASKET (CART. CAP COVER)
66	ROLLER BEARING CUP
67	ROLLER BEARING CONE
68	ROLLER BEARING CUP
69	ROLLER BEARING CONE
70	BALL BEARING
71	BALL BEARING
73	RETAINING RING
74	RETAINING RING
75	RETAINING RING
76	GREASE FITTING
77	LOCKNUT
78	ELASTIC STOP NUT
79	SPRING PIN
81	BUSHING
82	BUSHING
85	QUAD RING
86	QUAD RING
87	QUAD RING
88	PIPE PLUG
90	"O" RING
91	MOTOR TERMINAL BLOCK
92	MOTOR ASS'Y
93	TORQUE SWITCH ASS'Y
94	G. L. SW. CART. ASS'Y
95	G. L. SW. GEAR BOX SUB-ASS'Y
96	G. L. SW. PANEL SUB-ASS'Y

DIMENSIONS



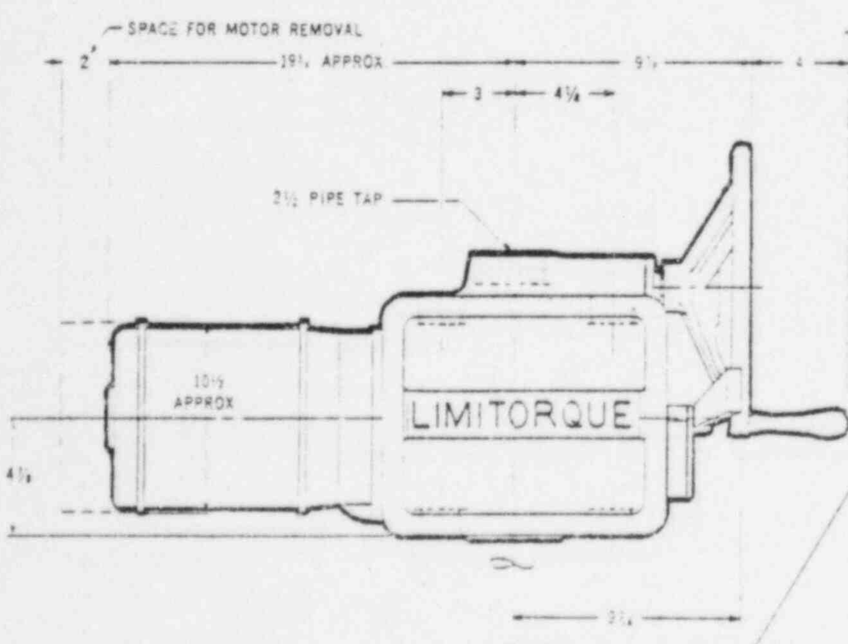


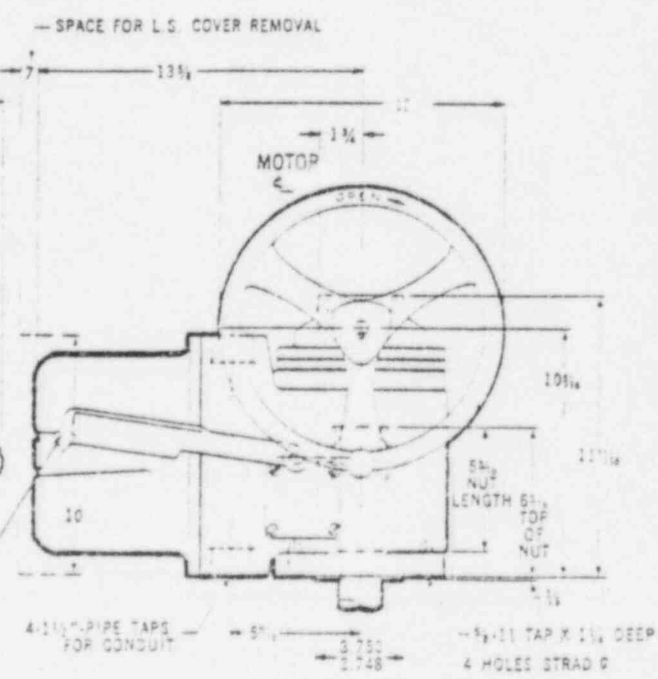
* { "A" MAX. STEM DIA. FOR 2 Pc. STEM NUT
  { "AY" MAX. STEM DIA. FOR 1 Pc. DRIVE SLEEVE

Unit Size	A Max.	C	D	E	F	H	J	K	L	M	N	P	R	S	T	W	X	AA	AB	AC	AE	AG	AH	AK	AL	AM	AN	AP	AS	AT	AU	AV	AW	AX	AY	AZ	BA
SMB-000	1⅛	2⅝	3¼	4½	⅜-16	4	4¼	10 15/16	7½	4 1/16	2	5	13 7/16	5	5	1 5/16	6 5/16	¼	½ DP	8⅛	1	10	7 5/16	10½	1	2	7⅛	2⅝	4	1¼	2	2 7/16	2 11/16	3 7/16	1½	15½	11
SMB-00	1¾	3¼	5½	7	½-13	4	5 11/16	13	7	5⅝	4⅛	6 5/16	19¾	10½	4⅛	1¾	7½	½	1¼ DP	9⅞	1½	10	9¾	13⅛	¾	2½	10	3	13 5/16	2⅛	2	3	4½	5 7/16	2	13½	7

FOR INSTALLATION PURPOSES USE CERTIFIED DIMENSIONS ONLY.

02-403-0002-3





* 1¾" MAX. STEM DIA. FOR 2 PIECE STEM UNIT
2" MAX. STEM DIA. FOR 1 PIECE DRIVE SLEEVE

MANUAL OPERATION PUSH IN DIRECTION OF ARROW ONLY. UNIT REMAINS IN HAND OPERATION UNTIL MOTOR IS ENERGIZED.

VALVE STEM THREADED LEFT HAND

02-403-0002-3

SMB-00 WITH HANDWHEEL BEVEL GEAR ATTACHMENT

FOR INSTALLATION PURPOSES USE CERTIFIED DIMENSIONS ONLY.

■ The SMB-000 and SMB-00 Limitorque valve controls are designed for those valves requiring smaller amounts of operating torques and thrusts. These units include all the main design features of the larger SMB units. However, due to a slight modification, their outside appearance is somewhat different than the larger units.

These smaller Limitorque units have the same insert type of stem nut as the larger controls. This feature allows transferring Limitorque units from one valve to another and replacement of stem nuts without major disassembly.

The SMB-000 and SMB-00 are now both available with controls built into limit switch compartment. These include:

Integral reversing controller for the motor.
Built-in pilot devices such as pushbuttons for open, stop and close.
Indicating lights.
Space heaters and control voltage transformers.

The SMB-00 was previously available with integral controls, but its redesign has allowed for additional devices and more compact design.

The SMB-000 and SMB-00 can also be obtained with built-in slide wire type position transmitters or the Selsyn type position transmitter when required.

The standard SMB-000 has a top mounted handwheel directly connected to the drive sleeve providing a 1:1 ratio. A side mounted handwheel is available only for the SMB-00 as an optional feature. With the side mounted handwheel a 4:1 ratio bevel gear set connects the handwheel to the drive sleeve. This arrangement is provided as standard equipment where torque requirements dictate.

■ Because of advanced design, precision machining methods, and improved metallurgy techniques these new larger Limitorque controls are able to develop more power in the same envelope than our previous models. All housings are of rugged cast iron construction.

In case of motor failure, the Limitorque unit can always be operated manually by use of a handwheel. To place the SMB unit in hand operation, a small lever is depressed which mechanically disconnects the motor from the gear train. The motor rotor will not turn when in manual operation.

In manual operation there is never any danger to operating personnel, since the handwheel is instantly disconnected from the gear train upon resumption of motor operation. However, the SMB type of Limitorque is always operable by motor as it automatically returns to motor operation as soon as the motor is re-energized.

The use of the declutch lever for manual operation prevents the undesired opening or closing of the valve by accidentally turning the handwheel.

Once Limitorque has returned to motor operation, it mechanically remains in this position until hand operation is again desired. This eliminates the need for clutch action each time the valve is operated and it further eliminates the possibility of clutch failure through constant engagement and disengagement.

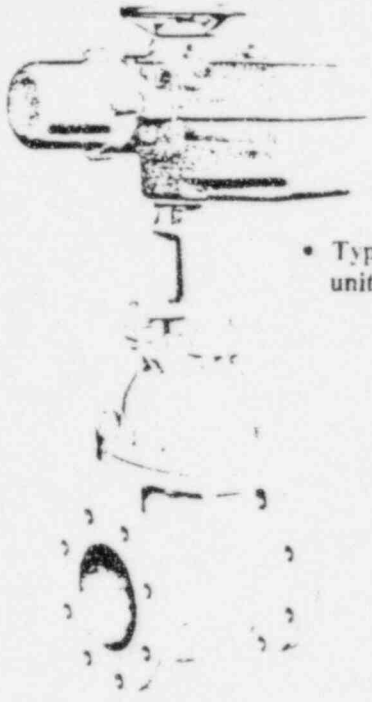
Electric motors are of the high torque type especially designed for valve control service, taking advantage also of the latest techniques and the use of materials for windings and insulation. They are available for a wide range of voltage and speed requirements. Although weatherproof construction is standard, they are also available for explosion-proof and Navy Class A high shock requirements. Motors are available having either Class A, B, H or F insulation. They are also available having windings with epoxy treatment.

Explosion-proof A.C. motors bear the Underwriters' label. All SMB Limitorque controls are equipped with improved designs of torque switches and geared limit switches.

The torque switch has been completely redesigned providing better contact arrangement and a much easier method of setting. The torque switch drive is now taken from a non-revolving spring cage thus eliminating a wear-point. In previous models the torque switch drive was taken off the revolving worm shaft.

■ All the features listed above are also applicable to the SMB-4 and SMB-5. In addition, these two units have been designed to provide more flexibility in application than was previously available. Both sizes can be furnished with suitable thrust bearings to absorb the thrust required to open or close a valve or they can be designed without thrust bearings. In the latter case, the thrust developed in opening or closing a valve would have to be absorbed by thrust bearings built into the valve yoke. These Limitorque operators would have the designation SMB-4T or SMB-5T. This type of operator transmits torque only to the valve stem nut. This arrangement in some cases can be more economical than furnishing the Limitorque operator with the thrust bearings built into it.

Limitorque Corporation meets the requirements for larger high pressure valve operators by having units with capacity in excess of 60,000 Ft. Lbs. of torque and 500,000 Lbs. of thrust. Specify Limitorque whenever you require motor operated valves.



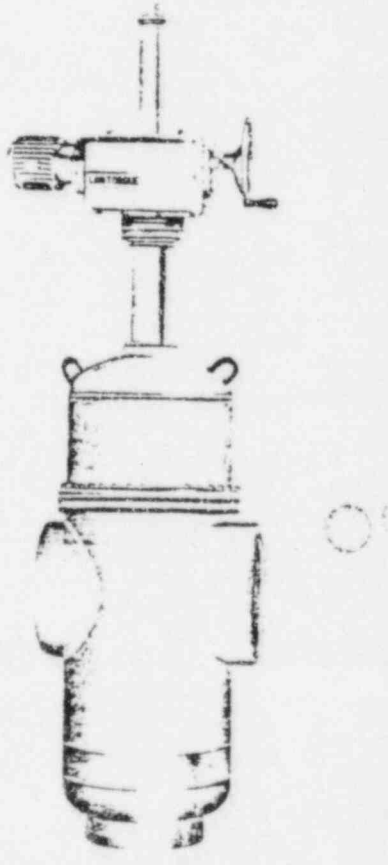
• Type SMB-000 Limitorque Valve Control unit mounted on a Gate Valve.

LIMITORQUE IS VERSATILE

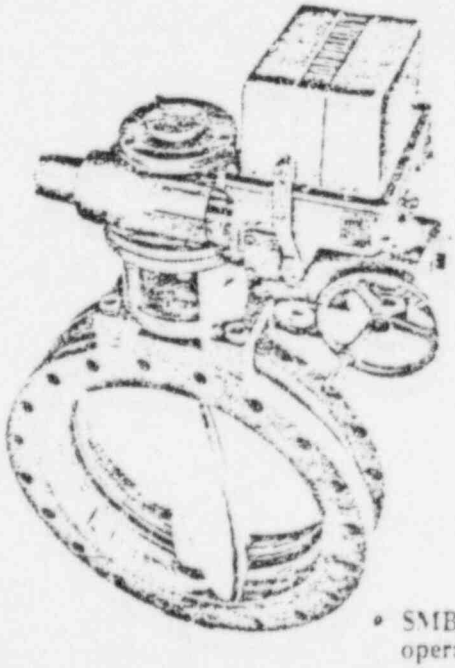
Limitorque has wide application and usefulness beyond the operation of conventional valves. Wherever controlled linear or rotary motion is required, a standard Limitorque control will do the job correctly and with great advantages of economy. Our engineers are ready to aid in the adaptation of Limitorque to the control and actuation of all types of mechanical equipment in a variety of applications.

■ With type SMB Limitorque units one can operate the five major types of valves—gate, globe, plug, ball and butterfly. In addition, many specialized valves are readily adapted to Limitorque operation. Numerous other applications involving mechanisms other than valves can be accomplished.

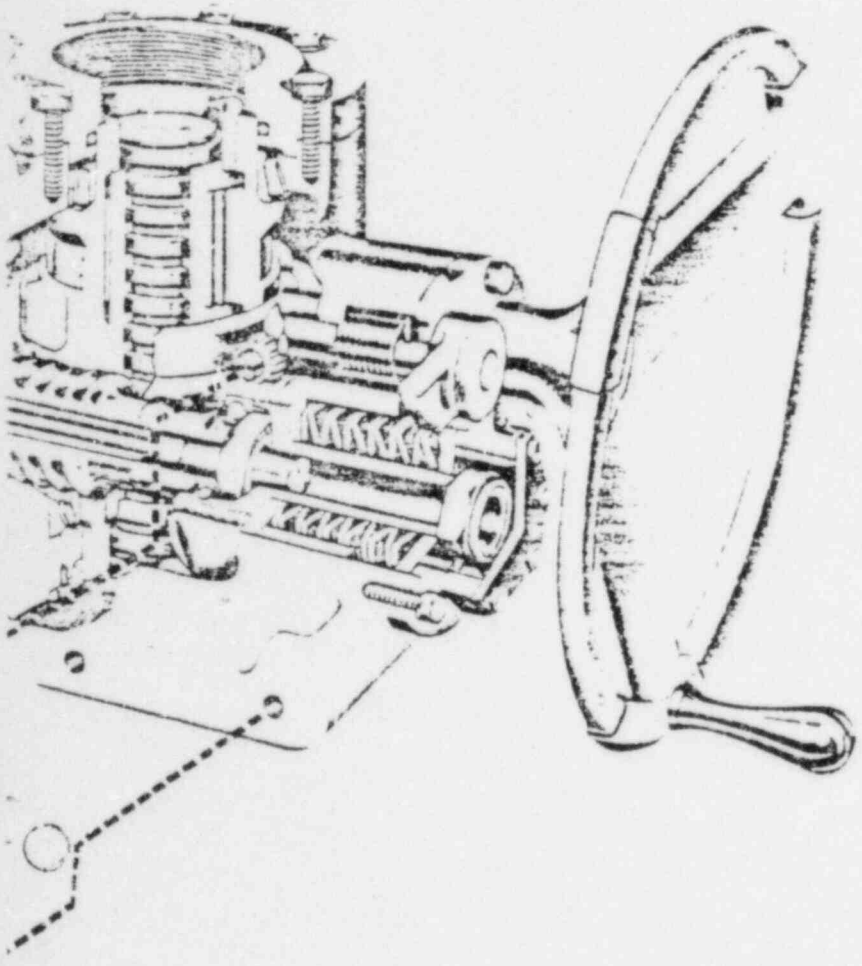
Usually, Limitorque units are mounted directly to gate and globe valves. Plug and ball valve operation is usually handled by mounting to the valve gearing. Butterfly valves are normally motorized by mounting the Limitorque unit to a manual operator to obtain additional gear ratio. This complete assembly is then mounted to the butterfly valve.



• SMB-1 Limitorque Valve Control unit mounted on a thru-conduit Gate Valve.



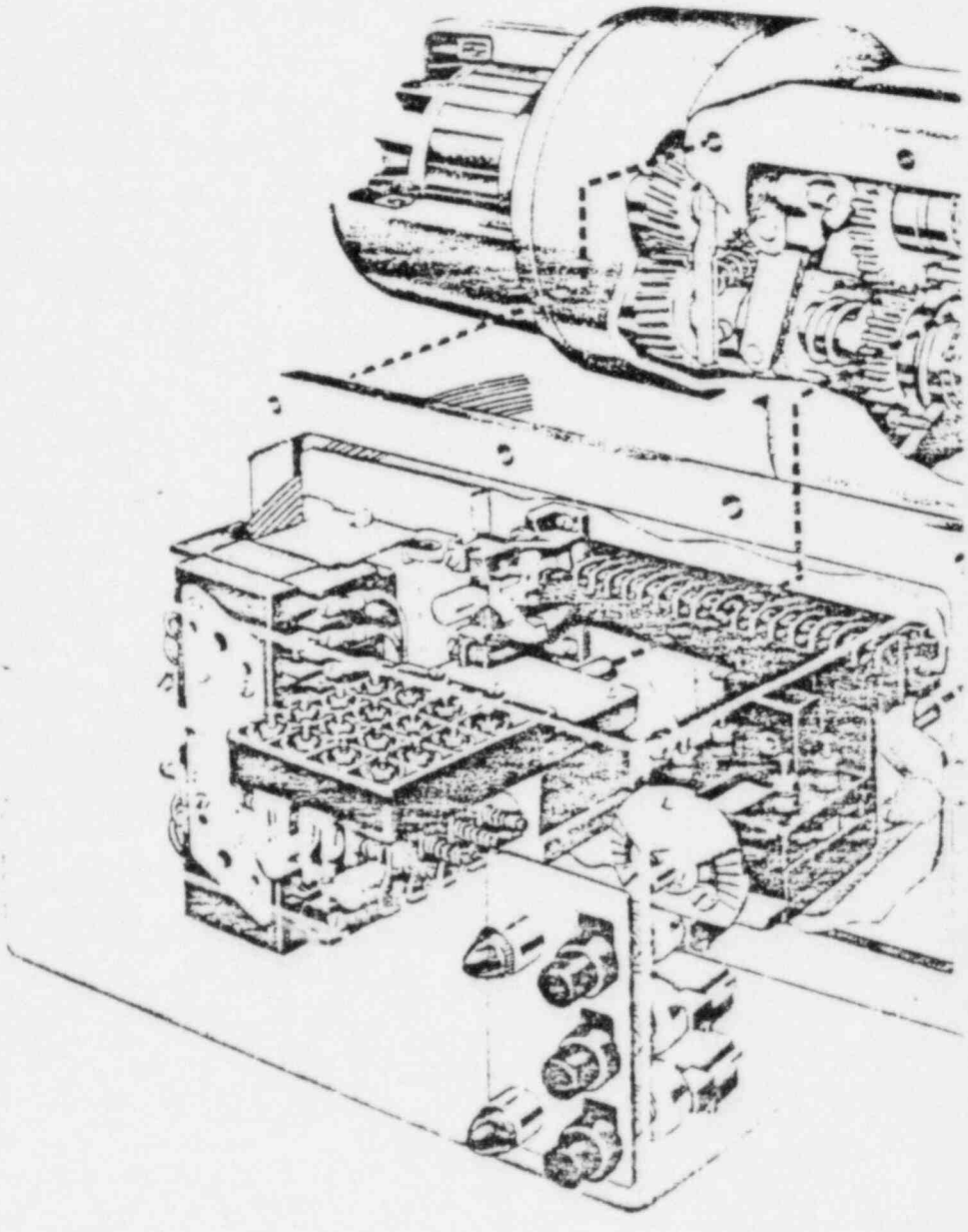
• SMB-00 Limitorque unit with HB manual operator mounted on a Butterfly Valve.



■ Limitorque is far more than a valve actuator. It also controls and limits the opening and closing travel of the valve. Proper valve seating is very important in automatic valve operation because most valves are damaged when they are improperly seated, or by meeting a foreign obstruction during seating. By limiting torque and thrust loads with its torque limit switch, Limitorque protects all valve operating parts from overload. Limitorque provides a constant seating thrust, thus assuring that a valve is absolutely ht on each closure and automatically compensates for alve wear. This seating thrust may be varied by means of a micrometer adjustment of the torque limit switch. Operating personnel are able to change easily the torque setting for other changing service conditions throughout the life of the valve.

The torque limit switch becomes operative and disconnects the source of motive power should an obstruction be met while closing the valve, regardless of whether this source be electricity, air, gas, or hydraulic pressure. In this manner, Limitorque prevents damaged valve seats, stems and discs.

The geared limit switch governs valve disc travel in the opening and/or closing direction of valve stem travel. It also regulates the position indicator lights for both opening and closing the valve. Either two or four train geared limit switches are provided. The switches are of the rotary drum type with four contacts per rotor. The geared limit switch and torque switch are always "in step" during both motor and hand operation.



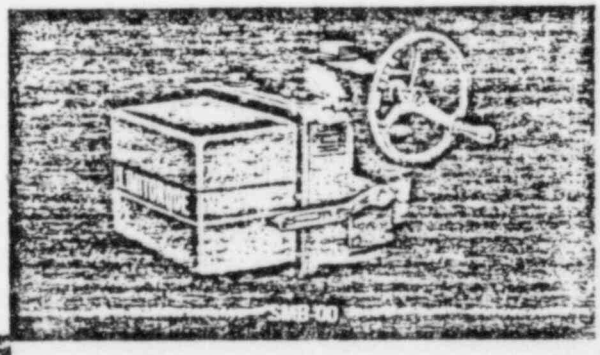
■ Limitorque is unique in its flexibility. Basically, it is a sensitive, automatic, power actuated device. It controls all types of valves, sluice gates and shipboard water-tight doors. If power fails, Limitorque can always be manually operated through a powerful handwheel control.

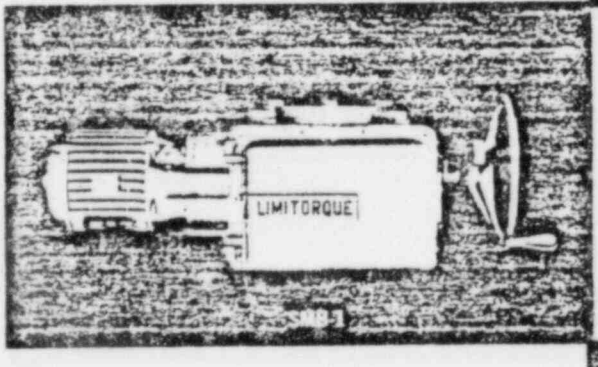
With Limitorque Controls, personnel need not manually operate valves. Limitorque is simple, economical and dependable, where fully automatic operation is desired, where valves are inaccessibly located, or where emergency requires rapid, positive operation from a remote point. Limitorque is absolutely safe for operating personnel because the handwheel cannot rotate during power operation. Limitorque may be mounted on any size valve in almost any position or location and can readily be adapted to existing equipment. It can be actuated by many power sources including electricity, hydraulic pressure, air, or high pressure natural gas. Gas and Oil Pipelines utilize VHF Microwaves as a means of initiating operation of remote valves.

Limitorque Valve Controls have been designed and perfected by Philadelphia Gear for over three decades. This experience plus pride in our product is your guarantee of safe, positive, and trouble-free valve operation. Our nation-wide engineering and sales organization is available to help you with your valve control problems.

BULLETIN 871

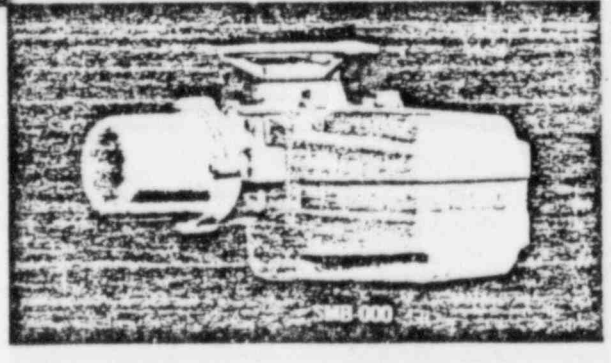
Limitorque



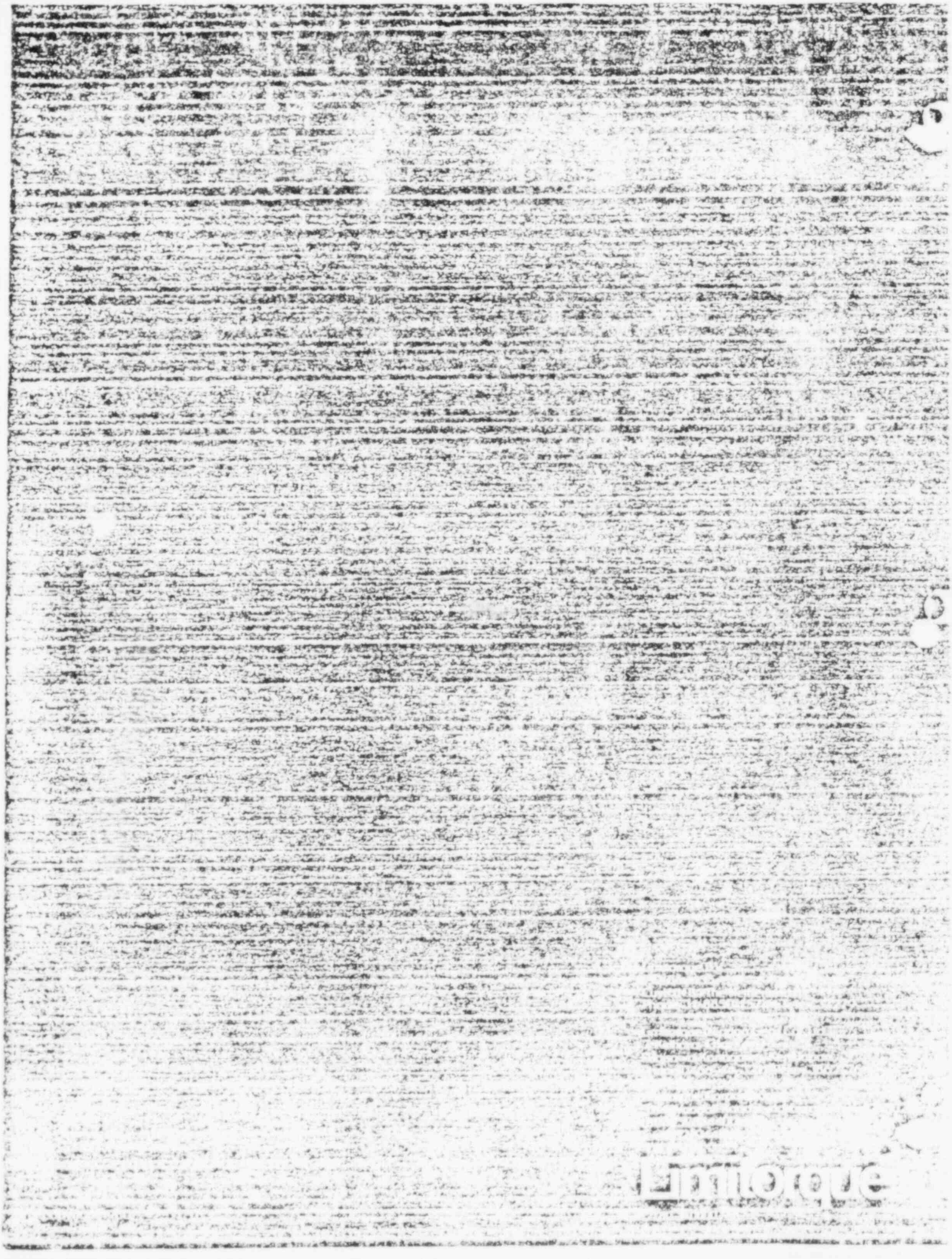


TYPE SMB

VALVE CONTROLS



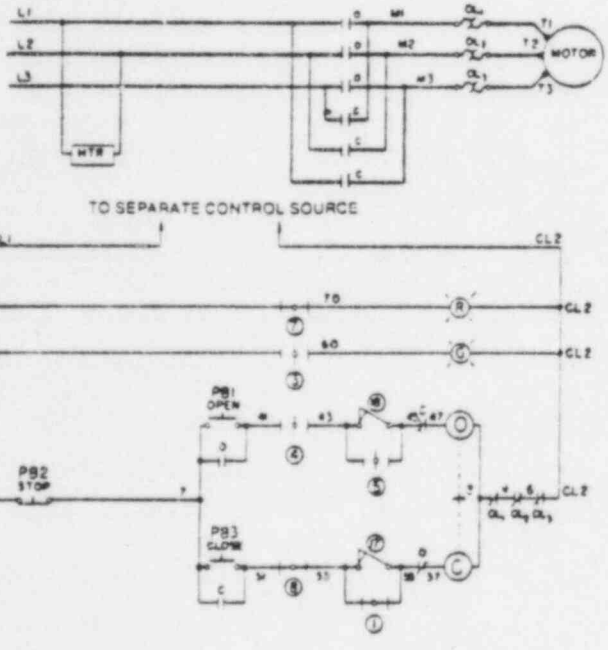
A PRODUCT OF LIMITORQUE CORPORATION

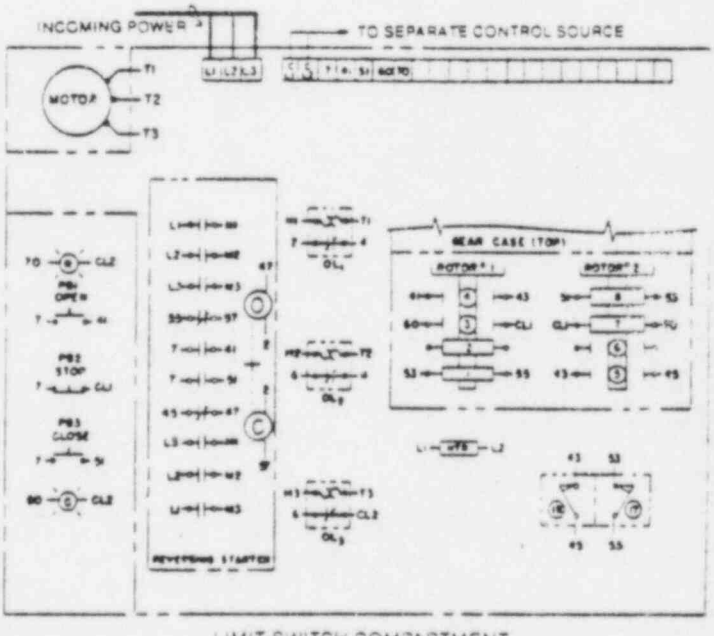


TYPICAL WIRING DIAGRAMS

Legend:

C – CLOSE CONTACT
O – OPEN CONTACT
(C) – CLOSING COIL
(O) – OPENING COIL
(G) – GREEN INDICATING LIGHT
(R) – RED INDICATING LIGHT
PB1 – OPEN PUSHBUTTON
PB2 – STOP PUSHBUTTON
PB3 – CLOSE PUSHBUTTON
OL – OVERLOAD RELAY (1, 2 & 3)
HTR – SPACE HEATER (LS COMP)
+ + – MECHANICAL INTERLOCK





15-476-0023-3

VALVE SHOWN IN FULL OPEN POSITION

REVERSE	CONTACT	LIMIT SWITCH COMPARTMENT: VALVE POSITION FULL OPEN	VALVE POSITION FULL CLOSED	FUNCTION
1	1	----------		BY PASS C.B.
	2	----------		SPARE
	3	----------		IND. LIGHT
	4	----------		OPEN LIMIT
2	5	----------		BY PASS C.B.
	6	----------		SPARE
	7		----------	IND. LIGHT
	8		----------	CLOSE LIMIT

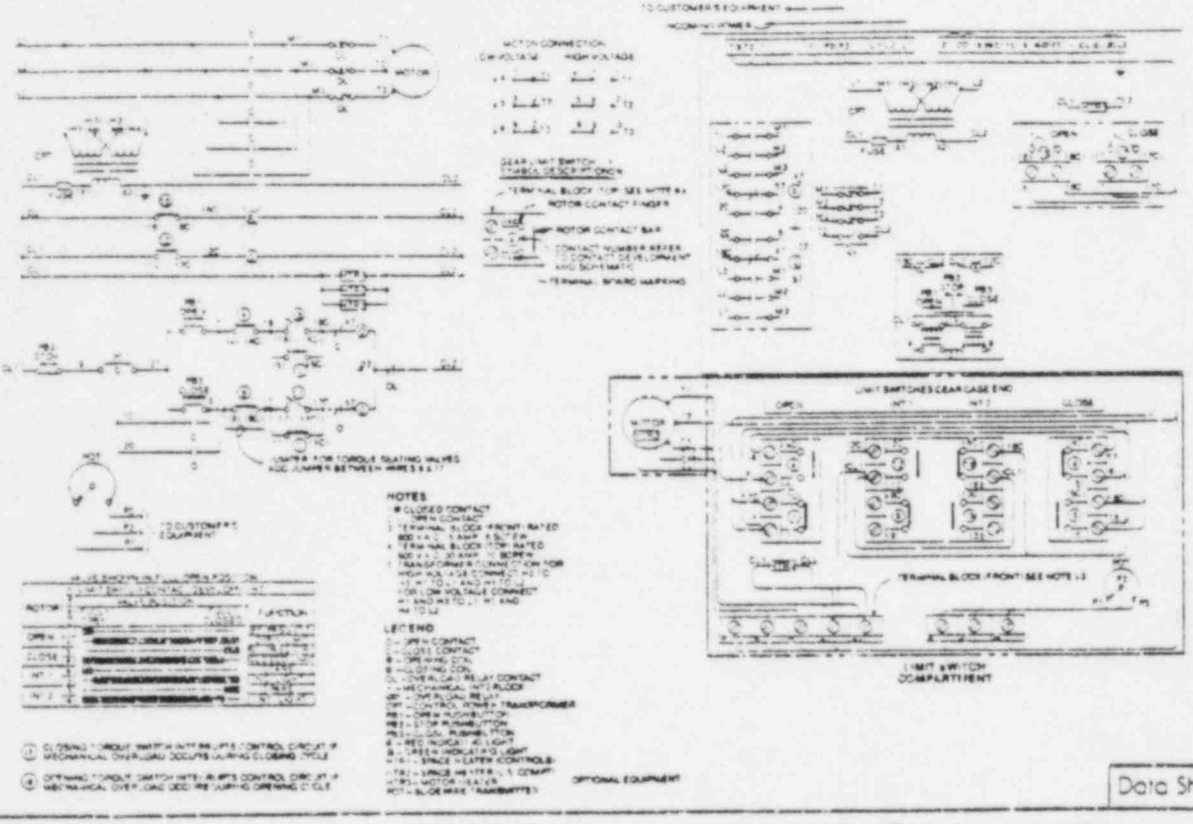
NOTES
1 ——— CLOSED CONTACT
2 - - - OPEN CONTACT

(17) CLOSING TORQUE SWITCH INTERRUPTS CONTROL CIRCUIT IF MECHANICAL OVERLOAD OCCURS DURING CLOSING CYCLE

(18) OPENING TORQUE SWITCH INTERRUPTS CONTROL CIRCUIT IF MECHANICAL OVERLOAD OCCURS DURING OPENING CYCLE

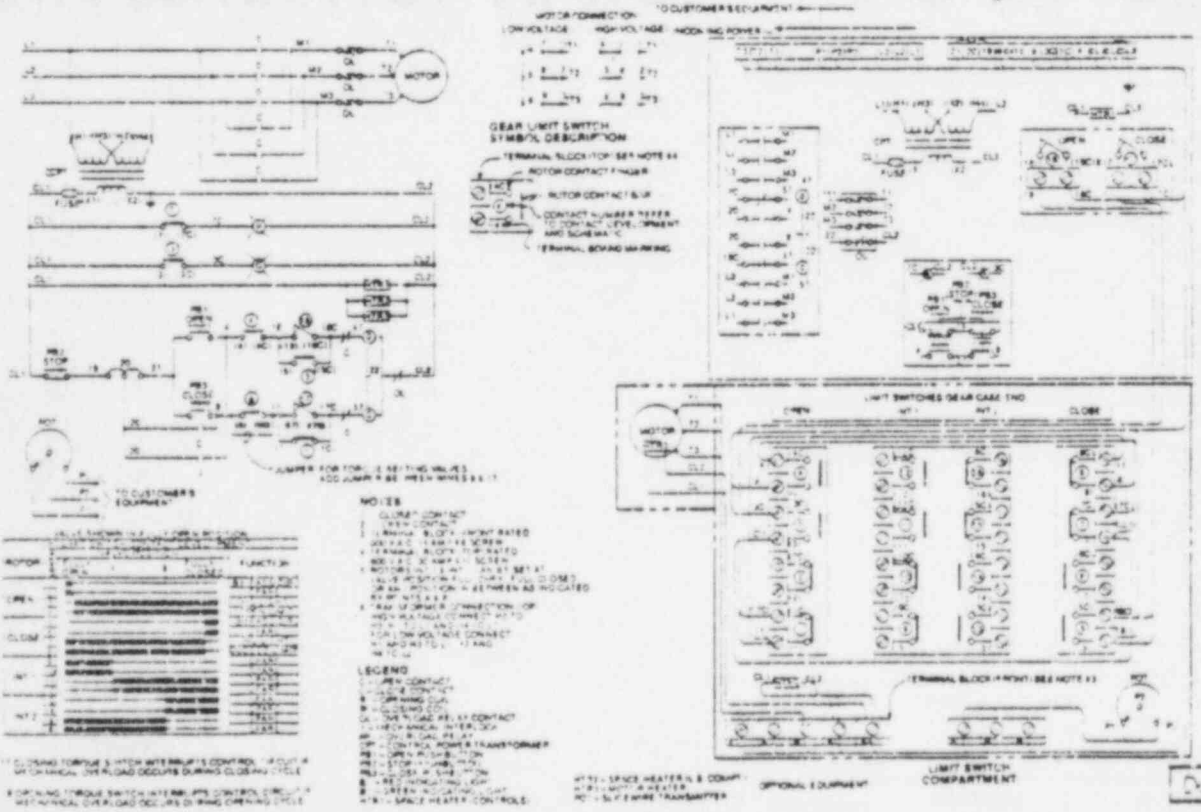
WIRING DIAGRAMS

UNIT WITH INTEGRAL CONTROLS AND SW PUSH BUTTON STATION 4 ROTOR/2 CONTACT



Data Sheet SMC-204

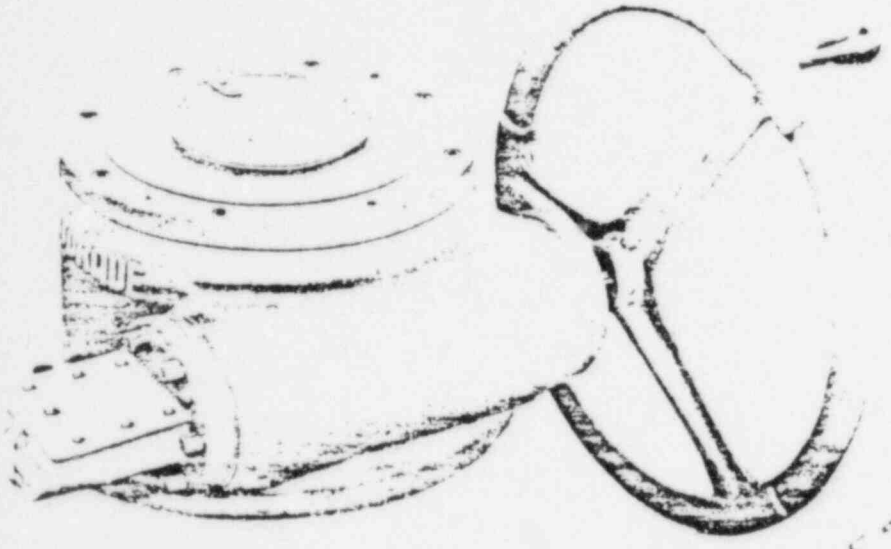
UNIT WITH INTEGRAL CONTROLS AND SW PUSH BUTTON STATION 4 ROTOR/4 CONTACT



Data Sheet SMC 205

LIMITORQUE VALVE CONTROLS

MANUAL TYPE HBC



Butterfly Valve manual operator size H3BC.

Motorized Limitorque Valve Control type SMB with H45C manual.

The hand operated type H-BC unit is a worm gear drive which may be used for any valve or device requiring a 90° movement. The H-BC manual gear operator is especially designed for operation of butterfly, plug and ball valves. Every H-BC operator has an adjustable mechanical stop limit device to prevent movement of the valve beyond 90° of travel. Instructions for setting these limit stops are described elsewhere in this bulletin.

The manual H-BC operator has an alloy steel worm shaft and a bronze worm gear. On all units, except for buried service, a valve position pointer is furnished as a standard part of the operator. On buried and submersible units, stainless steel non-corrosive input shafts are furnished. Handwheels are optional and can be furnished in various sizes as an extra.

All units are built to meet the requirements of A.W.W.A. specifications and when spur gear or bevel gear attachments are used, the maximum input torque is less than 80 ft.-pounds to develop the maximum output torque rating of the unit with standard or optional gear ratios.

All sizes of units can be furnished with Limitorque valve controls or can be readily converted for motor operation in the field using Limitorque valve controls. The speed of operation of butterfly, plug or ball valves, when motor operated, is usually 20 to 30 seconds, however this can be varied over a wide range limited only by motor speed and available gear ratios.

To size a manual operator, we need:

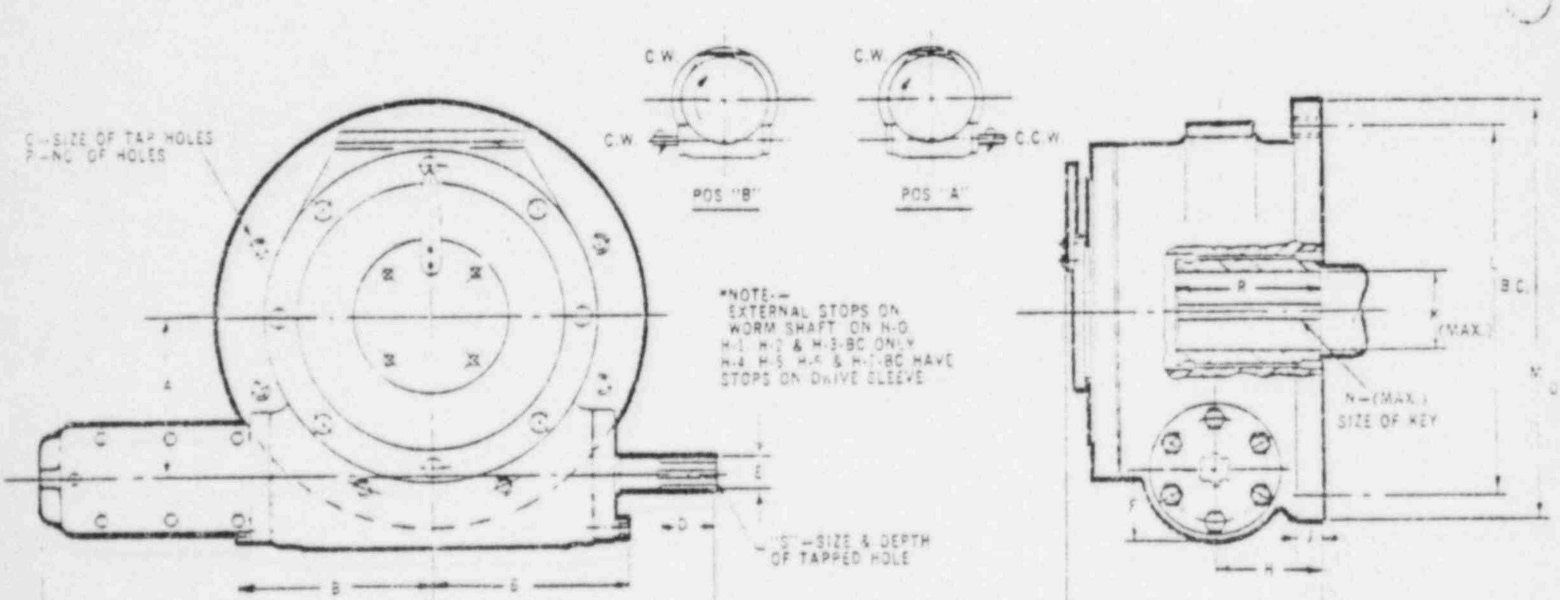
1. — Torque at valve shaft.
2. — Valve shaft and keyway size.
3. — Degrees of travel.
4. — Type of enclosure, weatherproof, buried or submersible. (If submersible, describe depth and time)
5. — Position of assembly.

For motor operation, in addition to the above, we need:

6. — Operating times.
7. — Voltage, phase and cycles (or DC volts).
8. — Type and frequency of service.
9. — Maximum ambient temperature.
10. — Class desired: weatherproof, explosion-proof, or submersible.
11. — Type of motor starter enclosure.
12. — Type of pushbutton station enclosure.

UNIT SIZE	OUTPUT TORQUE RATING INCH POUNDS	FT. POUNDS	WORM GEAR RATIO *	SPUR OR BEVEL GEAR ATTACHMENT RATIO *	TOTAL H.W. TURNS FOR 90° WITH ATTACH. SPUR OR BEVEL
H0BC	5,340	445	71:1	1:1 (bevel only)	17.7
H1BC	15,600	1,300	70:1	2.86:1	50
H2BC	26,400	2,200	70:1	2.86:1	50
H3BC	67,800	5,650	70:1	2.86:1	50
H4BC	153,600	12,800	60:1	12.0:1	180
H5BC	235,000	19,583	65:1	12.0:1	195
H6BC	552,000	46,000	66:1	38.9:1	641.8
H7BC	760,000	63,333	69:1	38.9:1	671

*ALTERNATE OPTIONAL RATIOS AVAILABLE ON REQUEST.



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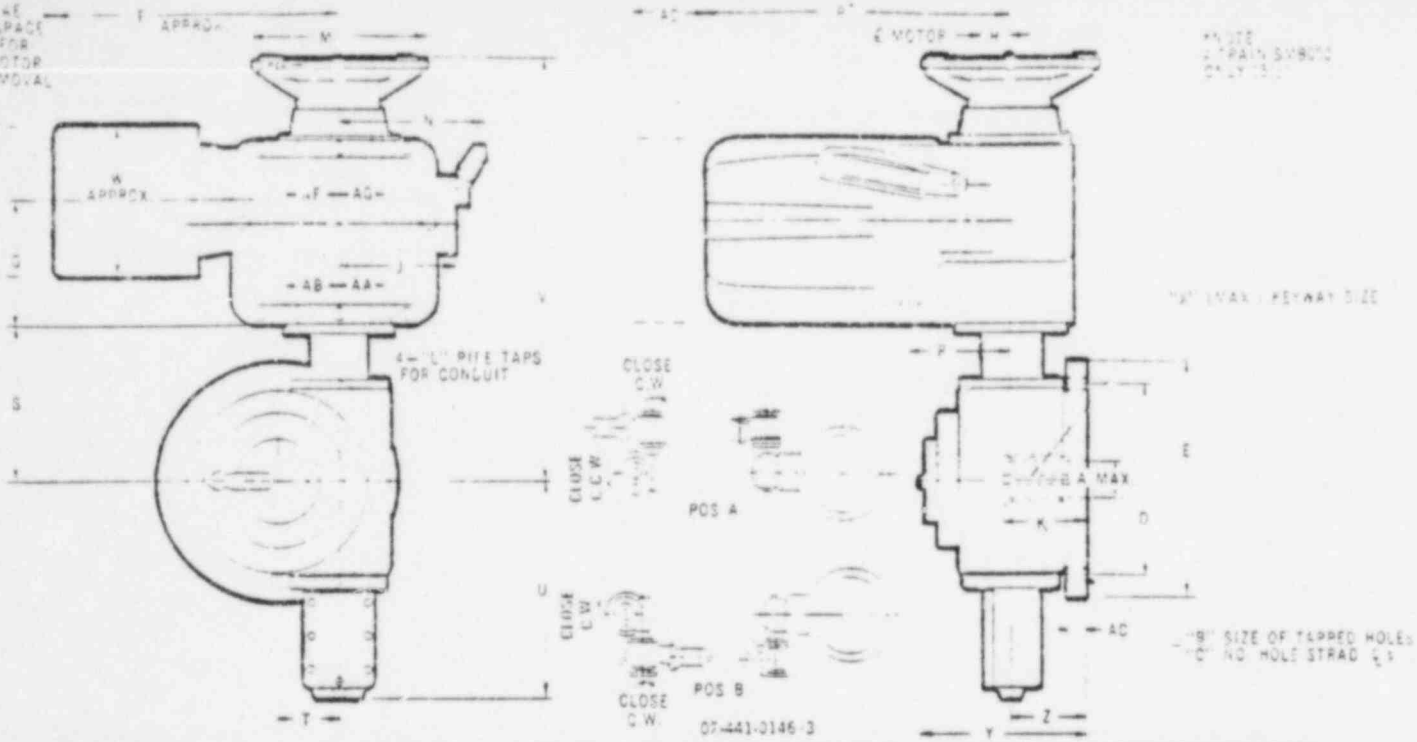
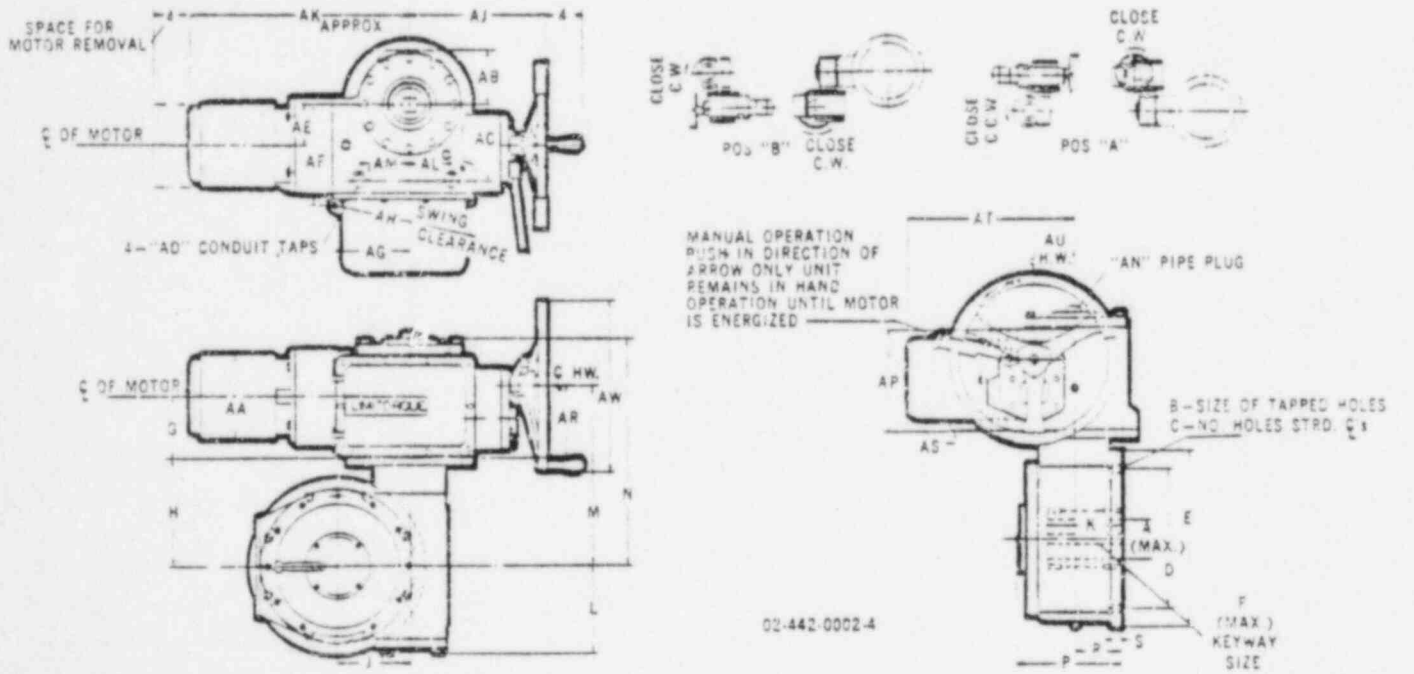
FOR INSTALLATION PURPOSES USE CERTIFIED DIMENSIONS ONLY.

UNIT SIZE	A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	R	INPUT SHAFT SPLINES	S	T
H-0-BC	2½	4⅝	[illegible]	1¼	1	[illegible]	[illegible]	3	¾	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	13 T. INV. SPL. [illegible] O.P.	[illegible]	[illegible]
H-1-BC	[illegible]	[illegible]	[illegible]	2	[illegible]	[illegible]	[illegible]	3⅝	[illegible]	[illegible]	10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	8 SPLINES 1.050 R.D. — .3125 WIDE 1.250—1.245 O.D.	[illegible]	[illegible]
H-2-BC	4¼	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3½	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]
H-3-BC	6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4½	1"	[illegible]	14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	12
H-4-BC	7½	[illegible]	13¼	3	1½	3½	[illegible]	4½	1"	4½	16	[illegible]	[illegible]	⅝-10	8	[illegible]	6 SPLINES 1.505 R.D. —.437 WIDE 1.749—1.745 O.D.	[illegible]	
H-5-BC	9½	[illegible]	14¼	3	1½	3½	[illegible]	5	1"	[illegible]	[illegible]	21	[illegible]	⅝-10	8	[illegible]		[illegible]	
H-6-BC	13	13¾	15⅛	4	2.415	4½	[illegible]	[illegible]	1½	7½	23	[illegible]	[illegible]	[illegible]	8	[illegible]	48 INVOLUTE SPLINES 12/24 D.P. 2.333 P.D.	[illegible]	
H-7-BC	16	[illegible]	[illegible]	4	[illegible]	3½	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	8	[illegible]	K.W. [illegible]	[illegible]	

NOTE: FOR SIZE H-7-BC WITHOUT SPLINED ADAPTER MAXIMUM BORE IS [illegible] WITH [illegible] KEY.



UNIT SIZE	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG
H0BC-SMB-000	1½	½-13	8	8¼	9	11½	5	15/16	6¾	3⅛	1	10	7¼	12½	3	6⅛	2½	9¾	17⅞	5⅛	⅜x⅛	6¾	3	2¾	3	¼	7½	2	2⅛	2
H1BC-SMB-000	1⅞	⅝-11	R	10	11⅜	11½	5	1⅝	6¾	4⅛	1	10	7¼	12½	3	7	3½	11⅜	18	5¼	½x⅜	8	3⅛	2¾	3	¼	7½	2	2⅛	2
H2BC-SMB-000	2⅛	¾-10	R	11¼	13½	11½	5	1⅝	6¾	5⅛	1	10	7¼	12½	3	7½	4¼	12⅛	18½	5½	⅝x¼	8	3¼	2¾	3	1	7½	2	2⅛	2
H0BC-SMB-00	1½	½-13	8	8¼	9½	17	4½	1¾	7½	3⅛	1½	10	9	13⅛	5	7¼	2½	9	18	7⅛	⅜x⅛	6¾	3	4⅛	3	¼	7	2	3	4⅛
H1BC-SMB-00	1⅞	⅝-11	8	HC	11⅜	17	4½	1¾	7½	4⅛	1½	10	9	13⅛	5	7	3½	11⅜	20	7½	½x⅜	8	3⅛	4⅛	3	¼	7	2	3	4⅛
H2BC-SMB-00	2⅛	¾-10	8	11¼	13½	17	4½	1¾	7½	5⅛	1½	10	9	13⅛	5	7½	4¼	12⅛	20½	7½	¾x⅜	8	3⅛	4⅛	3	1	7	2	3	4⅛
H3BC-SMB-00	3¼	¾-10	8	14	16	17	4½	1¾	7½	6	1½	10	9	13⅛	5	8⅛	6	13¼	21⅞	7⅛	¾x⅝	9	4⅛	4⅛	3	1	7	2	3	4⅛



UNIT SIZE	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	AA	AD	AE	AG	AJ	AK	AL	AM	AN	AP	AR	AS	AT	AU	AW
SMB0-HBC																															
SMB1-HBC																															
SMB2-HBC																															
SMB0-HBC																															
SMB1-HBC																															
SMB2-HBC																															
SMB0-HSP																															
SMB1-HSP																															
SMB2-HSP																															
SMB0-HBC																															
SMB1-HBC																															
SMB2-HBC																															

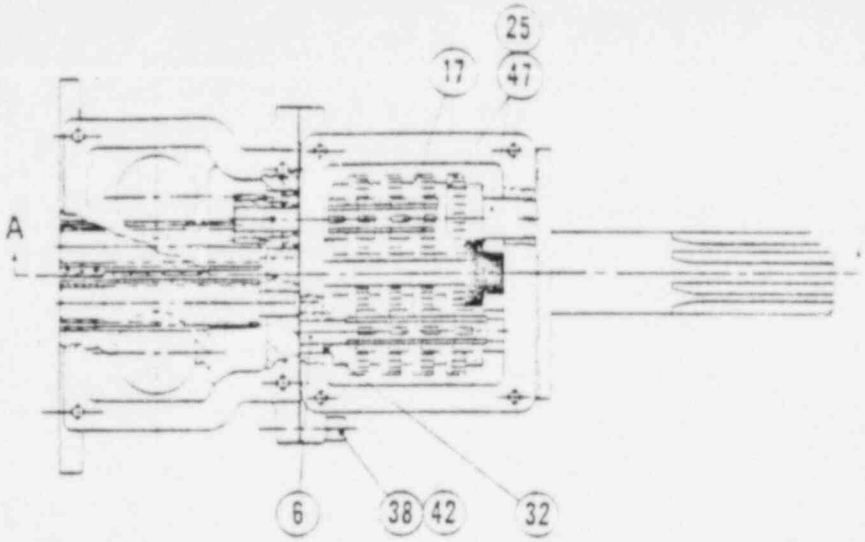
FOR INSTALLATION PURPOSES USE CERTIFIED DIMENSIONS ONLY.

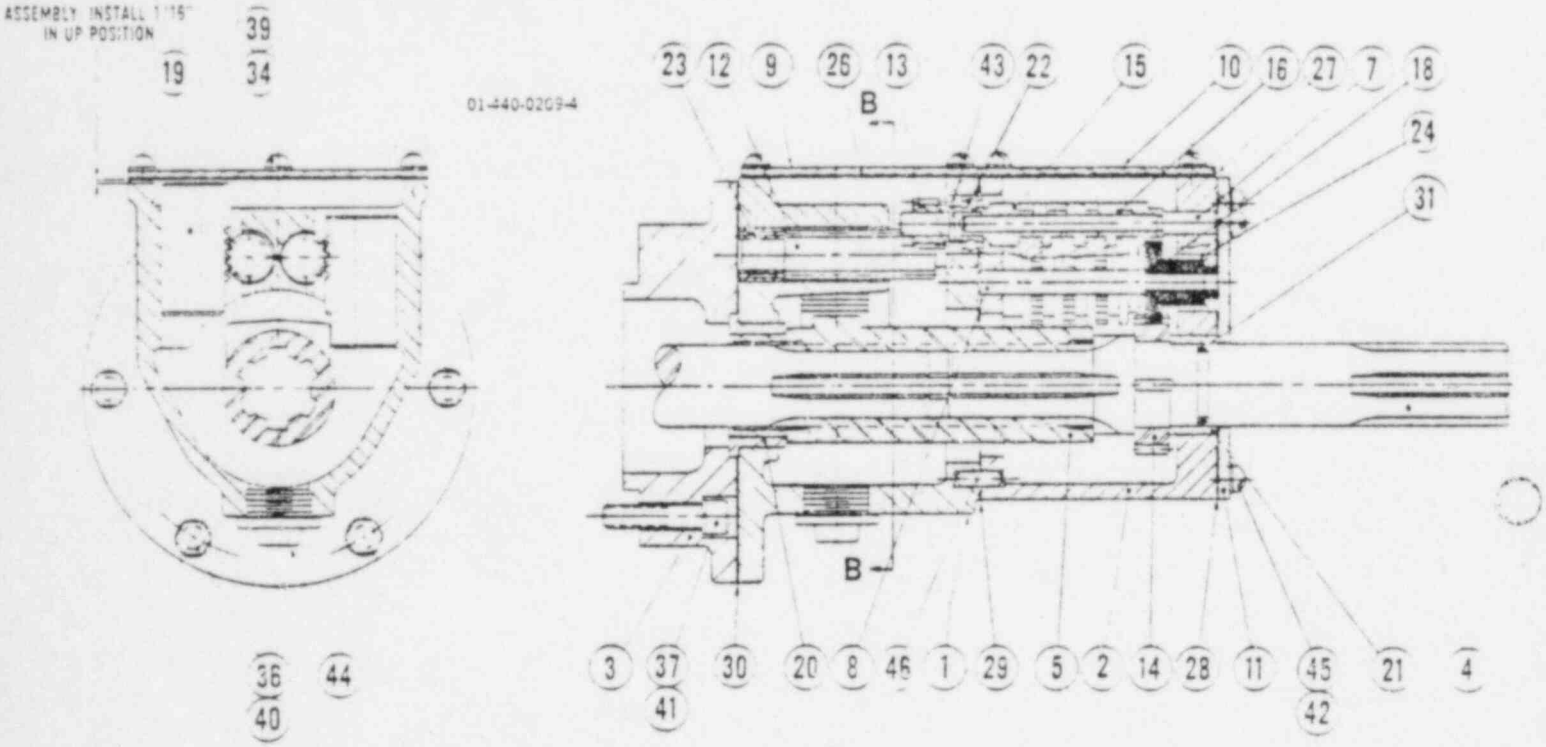
H-BC MANUAL-OPTIONAL FEATURE

AWWA INPUT SHAFT STOP*

PATENTED

* COMPLIES FULLY WITH AWWA SPEC. NO. C504-70





When the AWWA input shaft stop is used the standard limit stop is also furnished.

PC No.	DESCRIPTION	PC No.	DESCRIPTION
1	LIMIT STOP HOUSING	25	BUSHING
2	GEAR FRAME	26	INPUT PINION
3	LIMIT STOP HSG. ADAPTER	27	HOUSING COVER GASKET
4	INPUT SHAFT	28	GEAR FRAME COVER GASKET
5	SPLINED-LUG SLEEVE	29	THRU CAP GASKET
6	INTERMITTENT GEAR SHAFT	30	HOUSING GASKET
7	INTERMITTENT PINION SHAFT	31	ADAPTER GASKET
8	INTERMITTENT DRIVE SHAFT	32	"O" RING
9	COVER (LIMIT STOP HSG.)	33	BUSHING
10	COVER (GEAR FRAME HSG.)	34	CAP SCREW PD. HD. #10-32 x 1/2" LG.
11	GEAR FRAME THRU CAP	35	ROLL PIN 1/4" DIA. x 1/2" LG.
12	RACK PINION	36	CAP SCREW HEX. HD. 1/4-18 x 1" LG.
13	PINION	37	CAP SCREW SOC. HD. 7/16-14 x 1 1/2" LG.
14	INPUT GEAR	38	CAP SCREW SOC. HD. 1/4-20 x 7/8" LG.
15	INTERMITTENT STEM PINION	39	LOCK WASHER #10
16	INTERMITTENT PINION	40	LOCKWASHER 1/4"
17	INTERMITTENT GEAR	41	LOCKWASHER 3/8"
18	IDLER GEAR	42	LOCKWASHER 1/2"
19	RACK	43	ROLL PIN 1/8" DIA. x 5/8" LG.
20	FLANGED BUSHING	44	1" SD DRAIN PLUG
21	INPUT SHAFT BUSHING	45	CAP SCREW RD. SOC. HD. 1/4-20 x 1/2" LG.
22	INTERMITTENT STEM PINION BRG.	46	DOWEL PIN 1/4" DIA. x 3/4" LG.
23	RACK PINION BEARING	47	INPUT PINION-GEAR ASSY.

1. Refer to parts drawing #01-440-0209-4 and Figures A, B, C & D.
2. Remove cover plates, Pc. #9, #10 and #11.
3. Note the position of the racks, Pc. #19. The racks should be in the up position as shown in Figure A.
4. Note the position of the three (3) center punch marks on the end of the input shaft, Pc. #4. These center punch marks show the position of the lug on the lug sleeve, Item No. 5.
5. With the input shaft as shown in Figure A, pull the idler gear, Pc. #18, and hold it out of engagement with the input pinion, Pc. #47.
6. Rotate the handwheel on the input shaft clockwise until the valve reaches the extreme position of travel. With a normally clockwise handwheel rotation to close, the valve will go to the full closed position. If the valve is clockwise handwheel rotation to open, the valve will go to the full open position.
7. Place the input shaft in position as shown in Figure C.
8. Using a screwdriver, rotate the input pinion, Pc. #25 A, as shown in Figure B, clockwise until the rack, Pc. #19 A, moves downward as shown in Figure C. Do not rotate the pinion any further.
9. Push idler gear, Pc. #18, into engagement and rotate input shaft clockwise to check the setting. The lug should hit the rack and prevent further handwheel rotation.
10. Hold the idler gear, Pc. #18, engaged with the input pinion and rotate the input shaft, Pc. #4, counter-clockwise to the other extreme valve position. Do not allow the idler gear to come out of engagement. If the rack, Pc. #19 B, should trip to the down position as shown in Figure D, before the valve reaches the extreme position of travel, turn the input shaft back one turn, pull out of engagement, Pc. #18, place a screwdriver on the input pinion, Pc. #25 B, and rotate clockwise approximately 50 turns. Push idler gear, Pc. #18, into engagement again and rotate handwheel counter-clockwise until the valve goes to the extreme position of travel. Repeat as necessary until the valve reaches the point where the stop should be set.
11. With the valve in the position to be set, position the input shaft as shown in Figure D and with the screwdriver on Pc. #25 B, rotate the input pinion counter-clockwise until the rack, Pc. #19 B, moves as shown in Figure D. Do not rotate the pinion any further.
12. Push idler gear, Pc. #18, into engagement and rotate input shaft counter-clockwise to check setting. The lug should hit the rack.
13. Reassemble covers, Pc. #9, #10 and #11.
14. Open and close the valve fully to be certain position limit stops are set at the desired valve position.

CAUTION: FOLLOWING THESE INSTRUCTIONS EXACTLY WILL PREVENT JAMMING OR DAMAGING THE EQUIPMENT

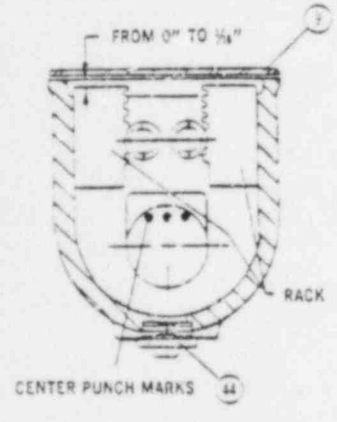


FIG. A

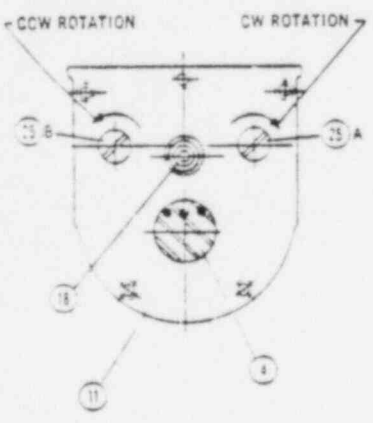


FIG. B

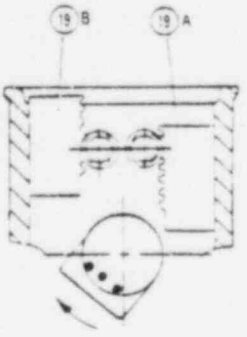


FIG. C

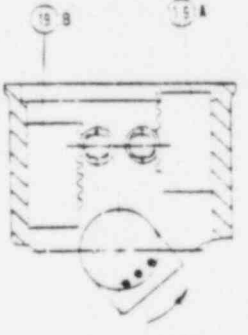
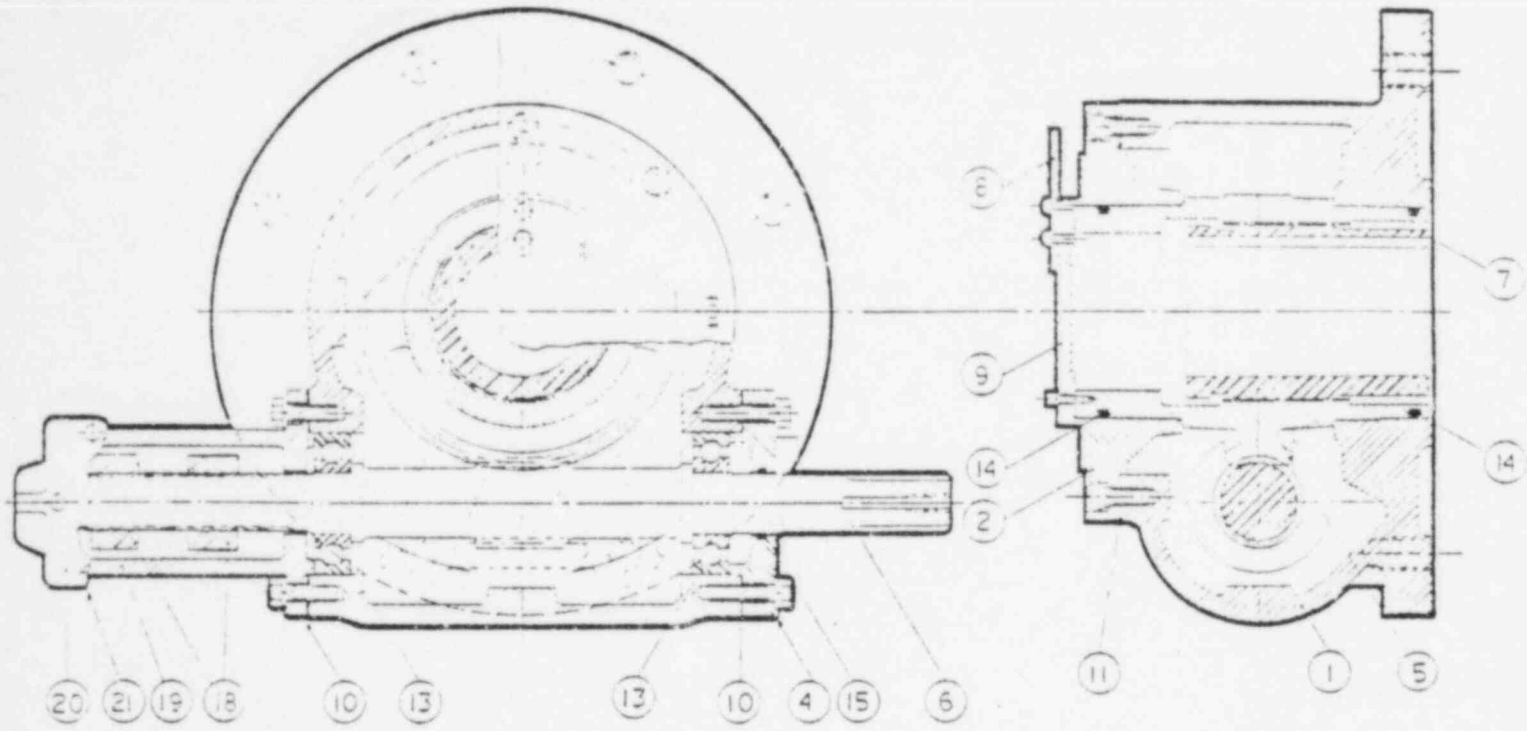


FIG. D



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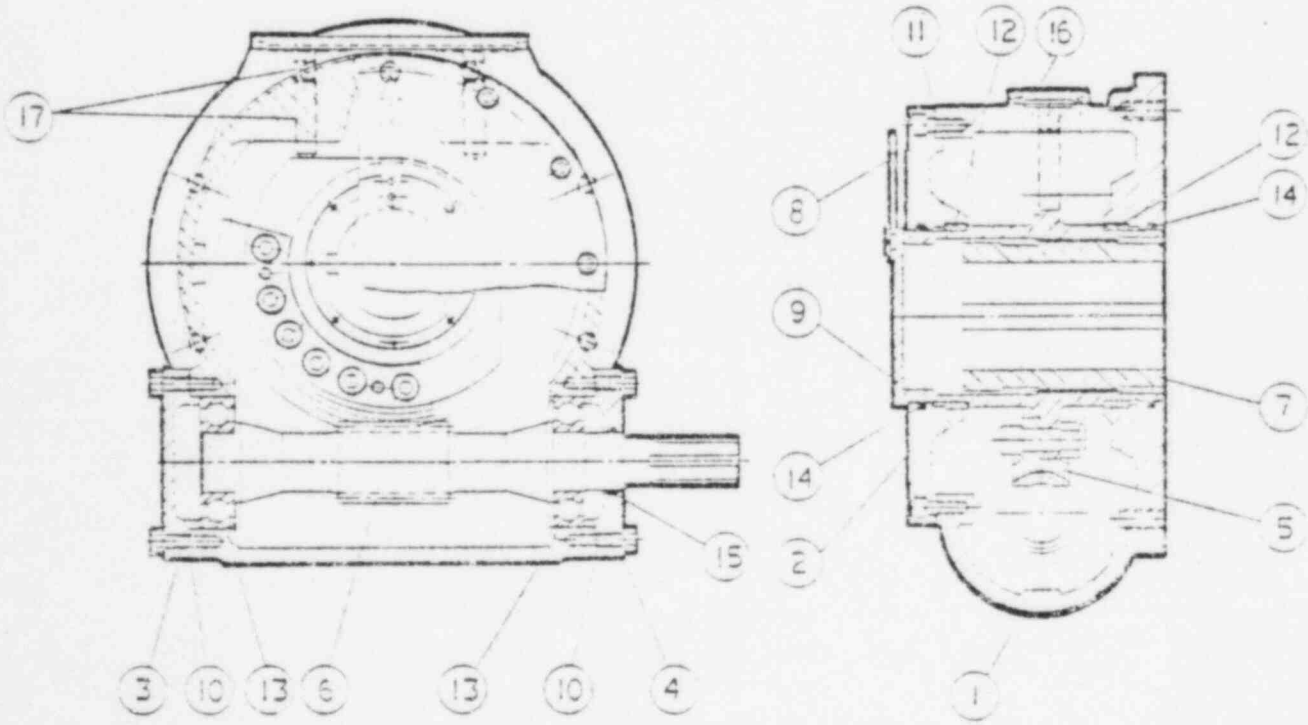
PC. NO.	DESCRIPTION	PC. NO.	DESCRIPTION	PC. NO.	DESCRIPTION
1	HOUSING	9	POINTER	15	WORM SHAFT "O" RING
2	HOUSING COVER	9	POINTER CAP	16	STOP SCREW COVER
3	END CAP	10	END & THRU CAP GASKET	17	STOP SCREW & LOCKSCREW
4	THRU CAP	11	HSG. COVER GASKET	18	HEX STOP NUT
5	DRIVE SLEEVE & WORM GEAR	12	DRIVE SLEEVE BUSHING	19	LIMIT STOP HOUSING
6	WORM SHAFT	13	WORM SHAFT BEARING	20	CAP LIMIT STOP HSG.
7	SPLINE ADAPTER	14	DRIVE SLEEVE "O" RING	21	LIMIT STOP HSG. GASKET*

*NOT SHOWN



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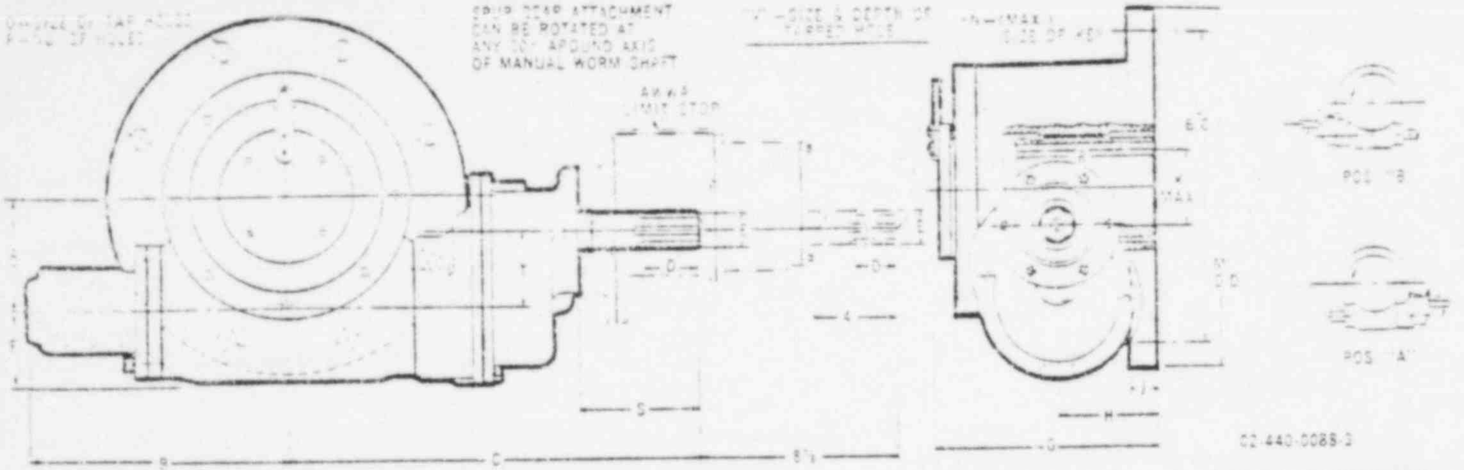
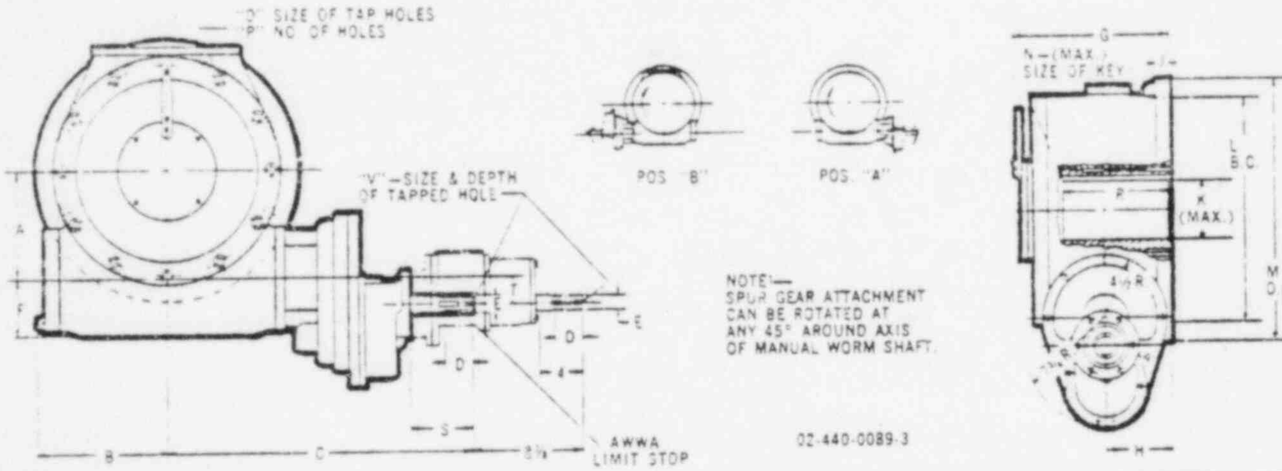
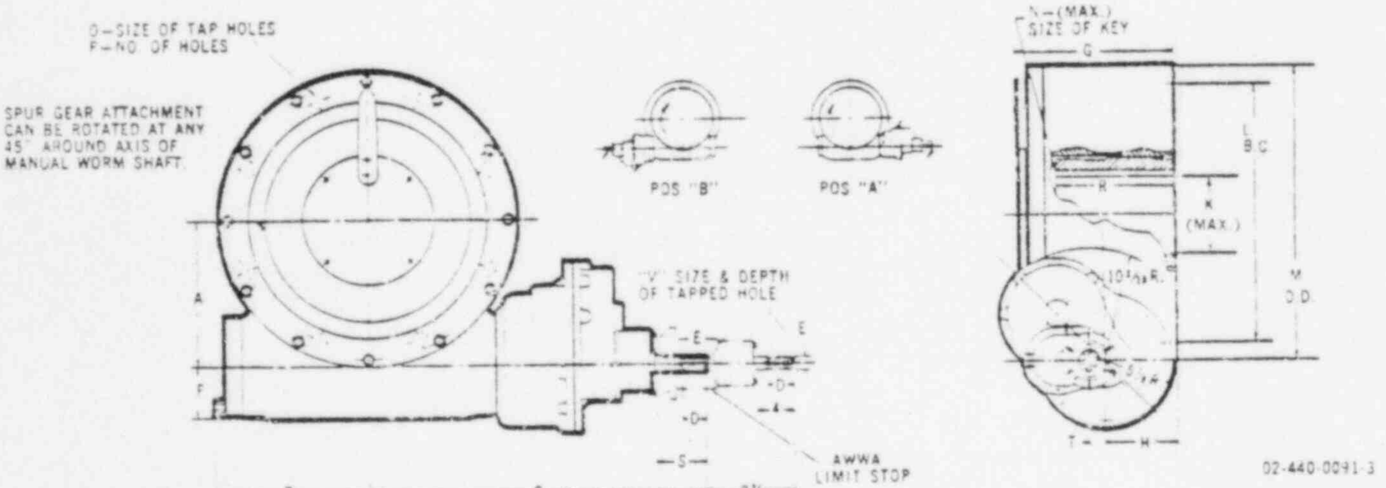


UNIT SIZE	A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	R	S	T	V	INPUT SHAFT SPLINES
H-1-BC	3½	11⅞	14¹³⁄₁₆	2	1¼	[illegible]	[illegible]	[illegible]	¾	1½	10	11¼	[illegible]	[illegible]	8	4½	4½	[illegible]	⅝-16x⅝	6 SPLINES 1.050 R.D. .3125 WIDE 1.250–1.249 O.D.
H-2-BC	4¾	12⅝	15⁷⁄₁₆	2	1¼	[illegible]	[illegible]	[illegible]	1	2½	11¾	13½	[illegible]	¾-10	8	5¼	4½	2½	⅝-16x⅝	
H-3-BC	6	13¾	18⁵⁄₁₆	2	1¼	2¹¹⁄₁₆	[illegible]	[illegible]	1	3½	14	16	⅝x⅜x6	¾-10	8	6	4½	2½	⅝-16x⅝	

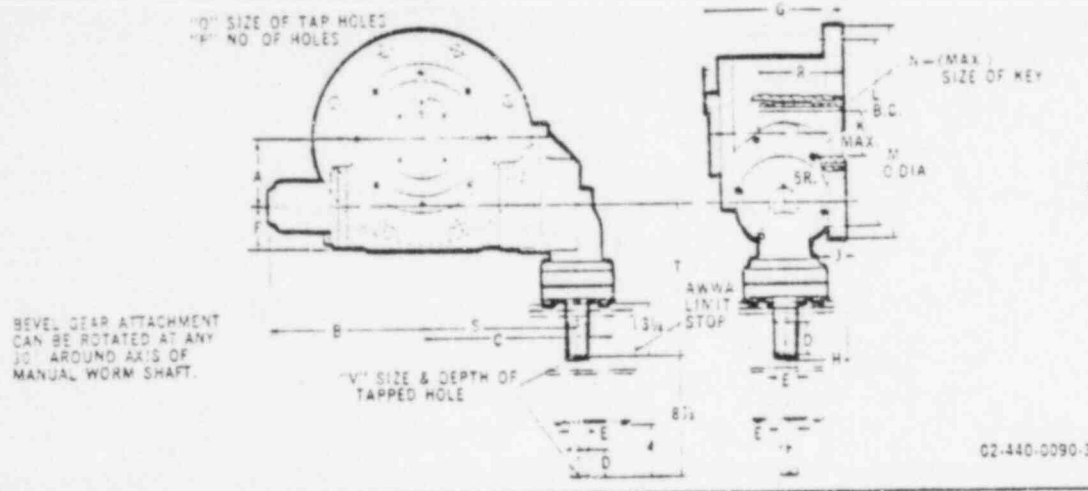


UNIT SIZE	A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	R	S	T	V	INPUT SHAFT SPLINES
H-4-BC	7⅝	9³⁄₁₆	21⅞	2	1¼	3½	10¹³⁄₁₆	4½	1	4½	16	18¾	1x½x7¾	¾-10	8	7¾	4½	2	⅝-16x⅝	6 SPLINES 1.050 R.D. .3125 WIDE 1.250–1.249 O.D.
H-5-BC	9¼	10³⁄₁₆	22¾	2	1¼	[illegible]	[illegible]	5	1	6½	18¼	21	1½x1x8½	¾-10	8	8¾	4½	2	⅝-16x⅝	

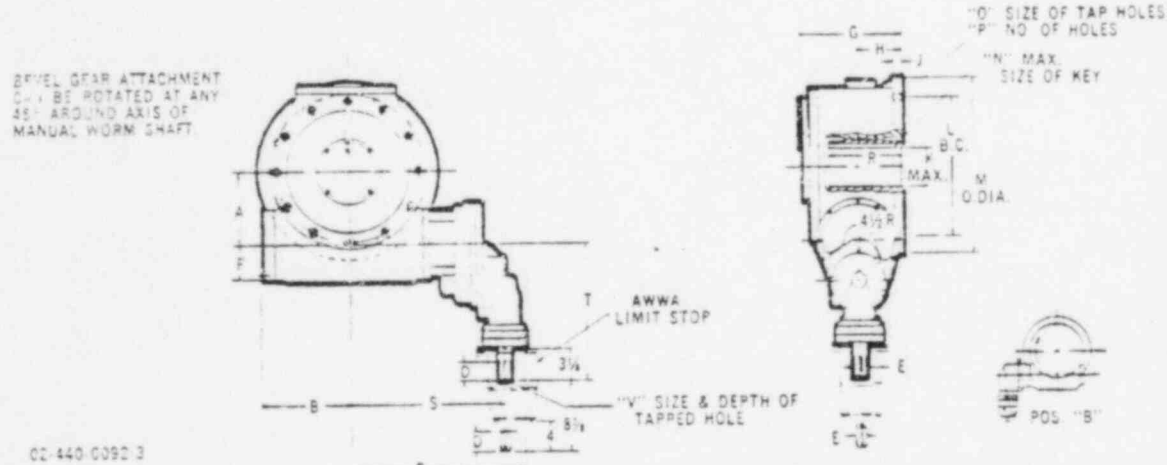


UNIT SIZE	A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	R	S	T	V	INPUT SHAFT SPLINES
H-6-BC	13	13⁵⁄₁₆	29¹¹⁄₁₆	[illegible]	1¼	4½	13¹¹⁄₁₆	6½	—	7½	23	26¾	1¾x1¼x10½	1¼-7	8	10½	4½	1⁹⁄₃₂	⅝-16x⅝	6 SPLINES 1.050 RD. .3125 WIDE 1.250–1.249 O.D.
H-7-BC	16	14¾	31¹⁄₁₆	2	1½	5⅝	14⅝	6¼	—	7½	29	31¾	1¾x1¼x 8½	1¼-7	8	8½	4½	1³⁄₃₂	⅝-16x⅝	

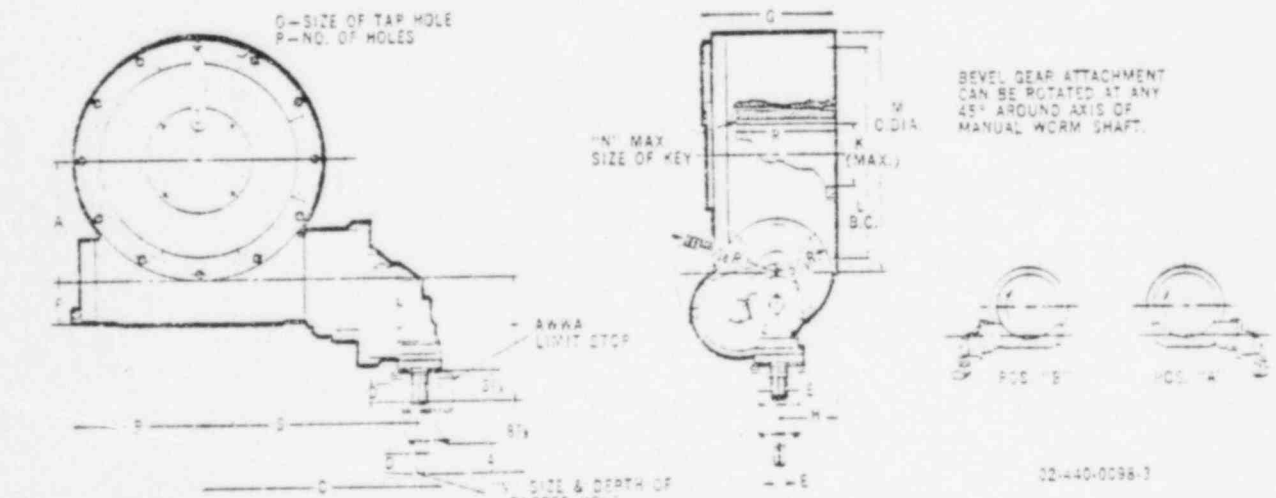
FOR INSTALLATION PURPOSES USE CERTIFIED DIMENSIONS ONLY.



UNIT SIZE	A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	R	S	T	V	INPUT SHAFT SPLINES
H-1-BC	3 11/32	11 3/16	11 1/16	2	1 3/4	2 1/32	8 1/16	3 1/16	1/4	1 3/8	10	11 7/8	1/2 x 1/2 x 4 5/8	1/4-10	8	4 3/16	9	9 3/16	5/8-16x4 1/4	6 SPLINES 1.050 R.D. .3125 WIDE 1.250—1.249 O.D.
H-2-BC	4 1/4	12 7/8	11 7/8	2	1 3/4	2 1/16	8 1/16	3 3/4	1	2 1/4	11 1/8	13 1/2	5/8 x 1/2 x 5 1/4	1/4-10	8	5 1/4	9 1/2	9 1/4	5/8-16x5 1/4	
H-3-BC	6	13 3/4	13	2	1 3/4	2 1/16	9 3/16	4 1/4	1	3 1/4	14	16	6 x 1/4 x 6	1/4-10	8	6	10 1/2	9 1/4	5/8-16x6 1/4	

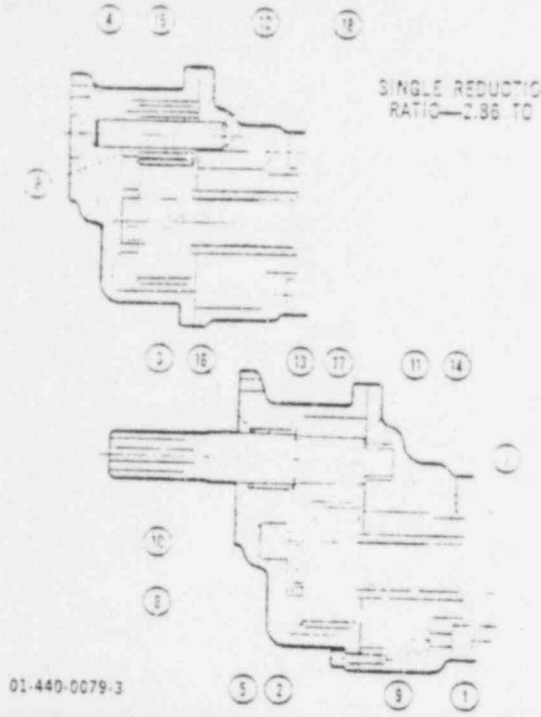


UNIT SIZE	A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	R	S	T	V	INPUT SHAFT SPLINES
H-4-BC	7 1/4	9 3/16	18 1/16	2	1 1/4	3 1/2	10 7/16	4 1/2	1	4 1/4	16	18 3/4	3/4 x 3/4 x 7 1/2	1/4-10	8	7 1/4	15 7/32	14 1/2	3/4-16x7 1/4	6 SPLINES 1.050 R.D. .3125 WIDE 1.250—1.249 O.D.
H-5-BC	9 1/4	10 11/32	18 1/16	2	1 1/4	4 1/4	13 5/16	5	1	6 1/4	18 1/4	21	1 1/4 x 1 x 8 1/2	3/4-10	8	8 1/4	15 7/32	14 1/2	3/4-16x8 1/4	



UNIT SIZE	A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	R	S	T	V	INPUT SHAFT SPLINES
H-6-BC	10	13 3/4	25 1/4	2	1 1/4	4 1/2	13 1/2	6 1/2	—	7 1/2	20	26	1 1/4 x 1 x 9 1/2	3/4-10	8	9 1/2	15 7/32	14 1/2	3/4-16x9 1/2	6 SPLINES 1.050 R.D. .3125 WIDE 1.250—1.249 O.D.
H-7-BC	11	14 1/4	27 1/4	2	1 1/4	5 1/2	13 1/2	6 1/2	—	7 1/2	20	26	1 1/4 x 1 x 9 1/2	3/4-10	8	9 1/2	15 7/32	14 1/2	3/4-16x9 1/2	

SINGLE REDUCTION
RATIO—2.86 TO 1



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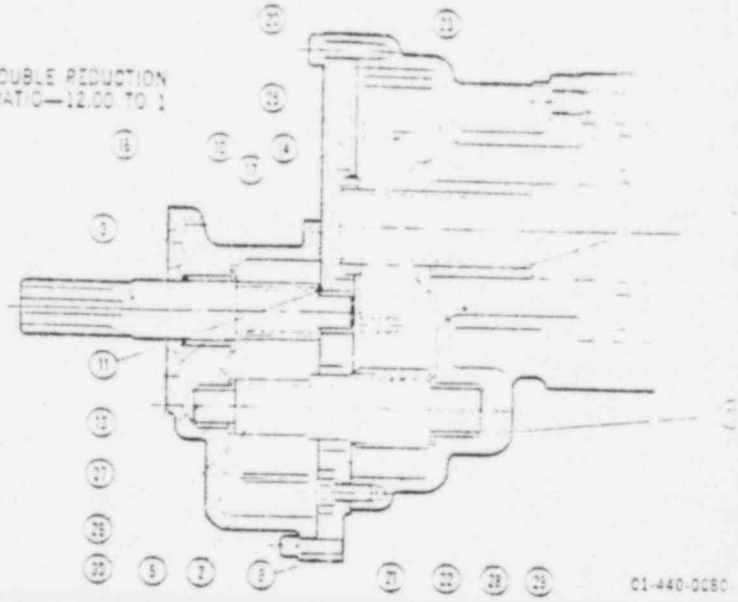
DOUBLE REDUCTION
RATIO—12.00 TO 1



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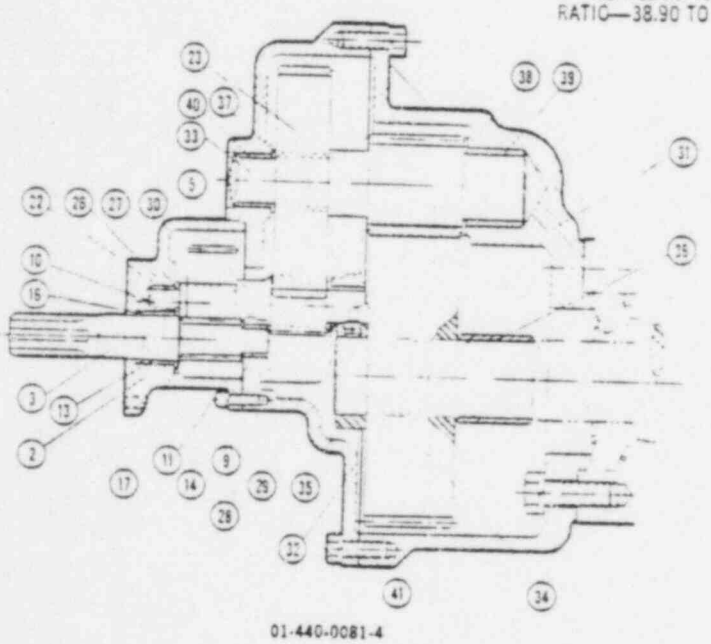
TRIPLE REDUCTION
RATIO—38.90 TO 1



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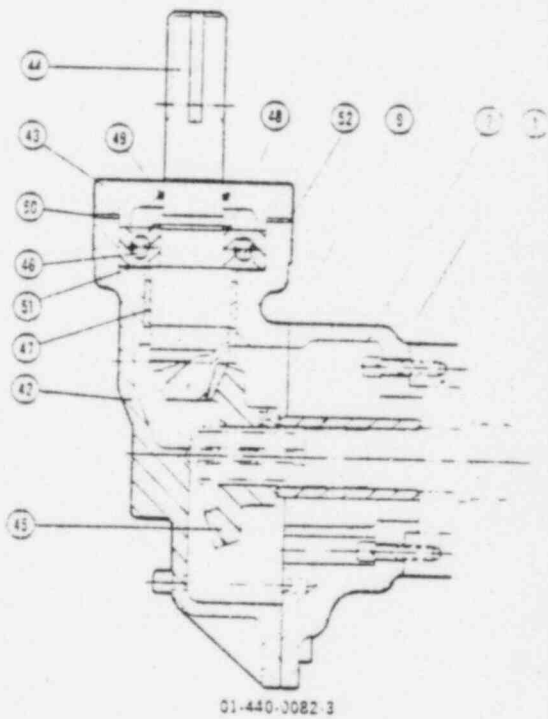
BEVEL GEAR RED
RATIO—2.8



01-440-0082-3

PC. NO.	DESCRIPTION	PC. NO.	DESCRIPTION	PC. NO.	DESCRIPTION
1	1ST. SET HOUSING ADAPTER	19	2ND SET HOUSING	37	THRUST BRG. OUTPUT PIN. & SHAFT
2	1ST SET HOUSING	20	2ND SET HOUSING ADAPTER	38	THRUST BRG. OUTPUT PIN. & SHAFT
3	1ST INPUT SHAFT & PINION	21	2ND HSG. GASKET	39	BRG. 3RD SET HOUSING
4	IDLER GEAR	22	INTERM. SHAFT & PINION	40	BRG. 3RD SET HSG. ADAPTER
5	1ST SET OUTPUT GEAR	23	2ND SET OUTPUT GEAR	41	3RD SET HSG. GASKET
6	1ST SET COLLAR	24	2ND SET OUTPUT SHAFT SPACER	42	BEVEL GEAR HOUSING
7	1ST SET OUTPUT GEAR SPACER	25	COLLAR OUTPUT GEAR 2ND SET	43	B. G. HSG. CAP
8	IDLER GEAR SPACER	26	BEARING INTERM. SHAFT	44	BEVEL PINION & SHAFT
9	1ST SET HOUSING GASKET	27	THRUST BRG. INTERM. SHAFT	45	BEVEL GEAR
10	THRUST BRG. INPUT SHAFT	28	THRUST BRG. INTERM. SHAFT	46	PINION SHAFT BEARING
11	THRUST BRG. INPUT SHAFT	29	BEARING 2ND SET HOUSING	47	PINION SHAFT BUSHING
12	THRUST BRG. IDLER GEAR	30	INTERM. SHAFT RETAINING RING	48	BEVEL PINION RETAINING RING
13	BEARING 1ST SET HSG.	31	3RD SET HOUSING	49	B. G. CAP "O" RING
14	BEARING 1ST HSG. ADAPTER	32	3RD SET HSG. ADAPTER	50	B. G. CAP GASKET
15	BEARING IDLER GEAR	33	INTERM. SHAFT & OUTPUT PINION	51	PINION SHAFT BRG. SHIM
16	QUAD RING INPUT SHAFT	34	3RD OUTPUT GEAR	52	PINION SHAFT CAP SHIM
17	RETAINING RING INPUT SHAFT	35	COLLAR OUTPUT GEAR 3RD SET		
18	IDLER SHAFT PIN	36	3RD SET OUTPUT SHAFT SPACER		

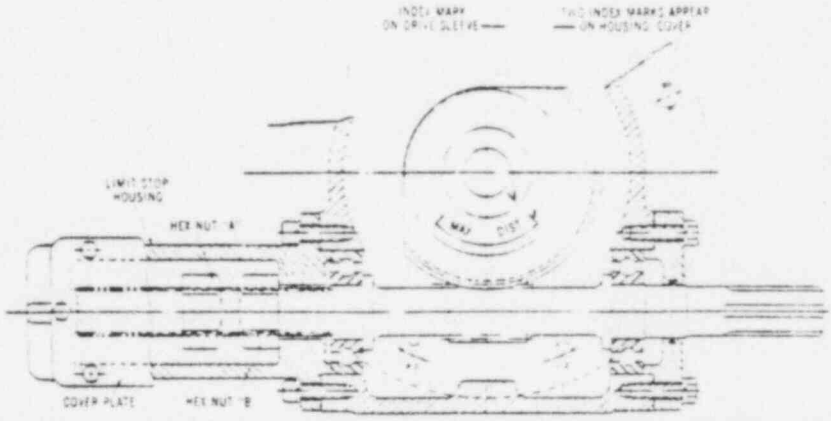
MOUNTING INSTRUCTIONS:

1. Place valve in full closed position.
2. Press splined shaft adapter on valve shaft and key in place.
3. Remove pointer cap from H-BC operator.
4. Turn H-BC operator input shaft to full closed position. The stop nut is preset for full travel. Be certain of correct direction of rotation.
5. Back off on input shaft one full turn.
6. Mount operator on valve and bolt securely.
7. Check stop limit nut setting for exact travel on H0BC thru H3BC units (see below).
8. If H4BC or larger operator is used, the set screw type position limit stop, as shown on page 6, is used to adjust maximum travel.
9. Units with A.W.W.A. input shaft stop, see instructions page 4.

SETTING POSITION LIMIT STOPS H0BC THRU H3BC UNITS:

HEX-NUT TYPE STOP

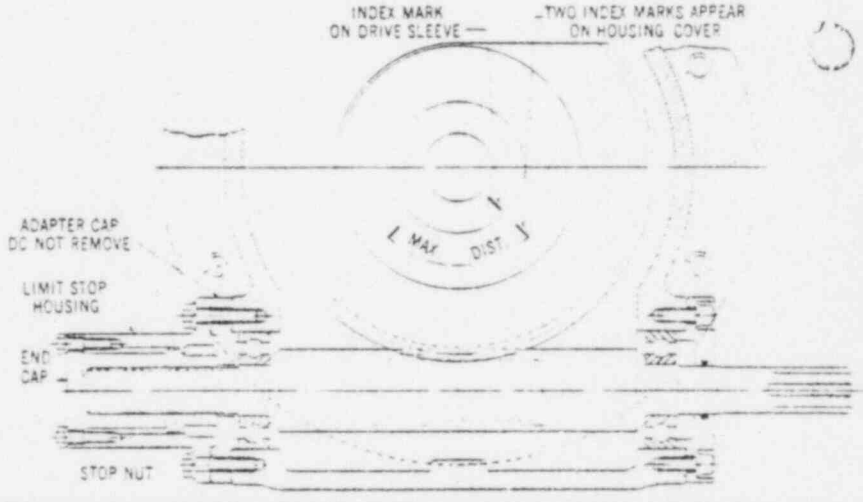
1. With valve vane in full closed position, remove limit stop cover plate.
2. You will note two travelling hex nuts, A and B. If hex nut B is near the position shown, run the hex nut hand tight against the housing and so that one of the flats of the hex nut is on top so as to face the cover plate.
3. Replace the limit stop cover plate and turn input shaft of H-BC operator to fully open the valve.
4. Remove limit stop cover plate and check position of hex nut A. This nut should be turned until it is flush up against the end of the limit stop housing and one of the flats of the nut is on top facing the limit stop housing cover plate.
5. Bolt limit stop cover plate in position.



KEY-NUT TYPE STOP

1. With valve in full closed position, remove end cap and limit stop housing.
2. If stop nut is near the adapter cap (as shown), run stop nut hand tight against the adapter cap face.
3. Slip on the limit stop housing and rotate limit stop housing to line up the nearest set of holes in adapter cap.
   If stop nut is nearest extreme end of worm shaft, slip limit stop housing into position and rotate to move stop nut flush with end of limit stop housing.
4. Bolt limit stop housing in position and assemble end cap.

NOTE: THE SETTING OF THE LIMIT STOP FOR THE CLOSED POSITION AUTOMATICALLY SETS THE OPEN STOP FOR 90° OF TRAVEL.



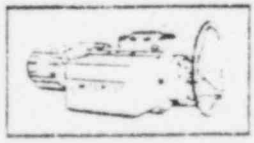
MAINTENANCE AND SERVICE INSTRUCTION:

All units are completely factory lubricated with grease. A periodic check, every six months, should be made to determine condition of the lubricant. Any lubricant equivalent to Esso Nebula EP-1 is acceptable for temperatures 0°F to −150°F. For lower temperatures, a grease equal to Esso P-290 is satisfactory. Sufficient grease should be installed to cover all gears. If the unit must be removed from the valve, the position limit stops must be reset in order to insure proper operation. Follow directions described above. There is an index mark on the main drive sleeve, shown above, indicating the center of the worm gear. There are two index marks on the housing cover to assist in lining up the worm gear to indicate both extreme positions of travel.

WHEN ORDERING SPARE PARTS, it is extremely important to reference the part number as determined from Parts Drawings in this bulletin, the size of H-BC operator, the unit serial number and order number which is stamped on the nameplate attached to the operator.

LIMITORQUE CORPORATION

5114 WOODALL ROAD • LYNCHBURG, VA. 24502



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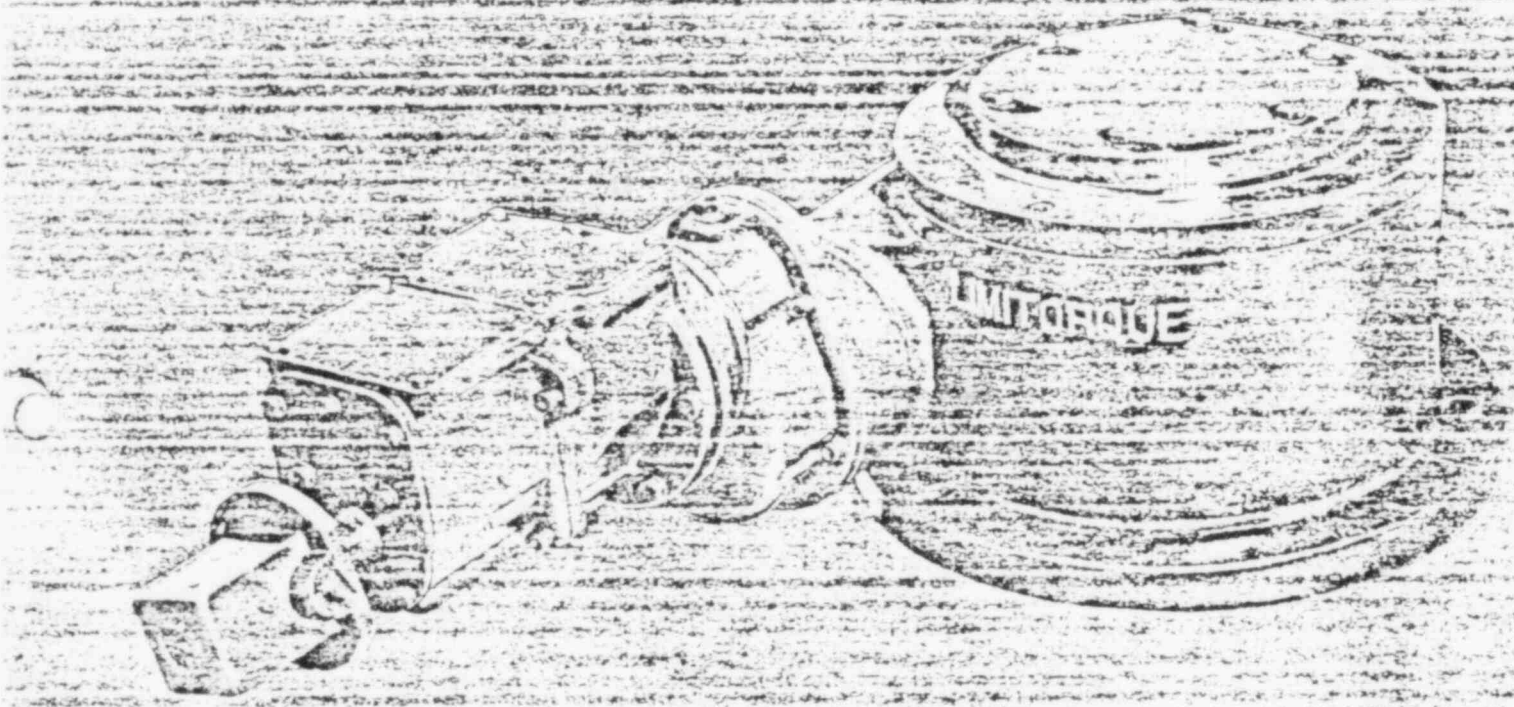
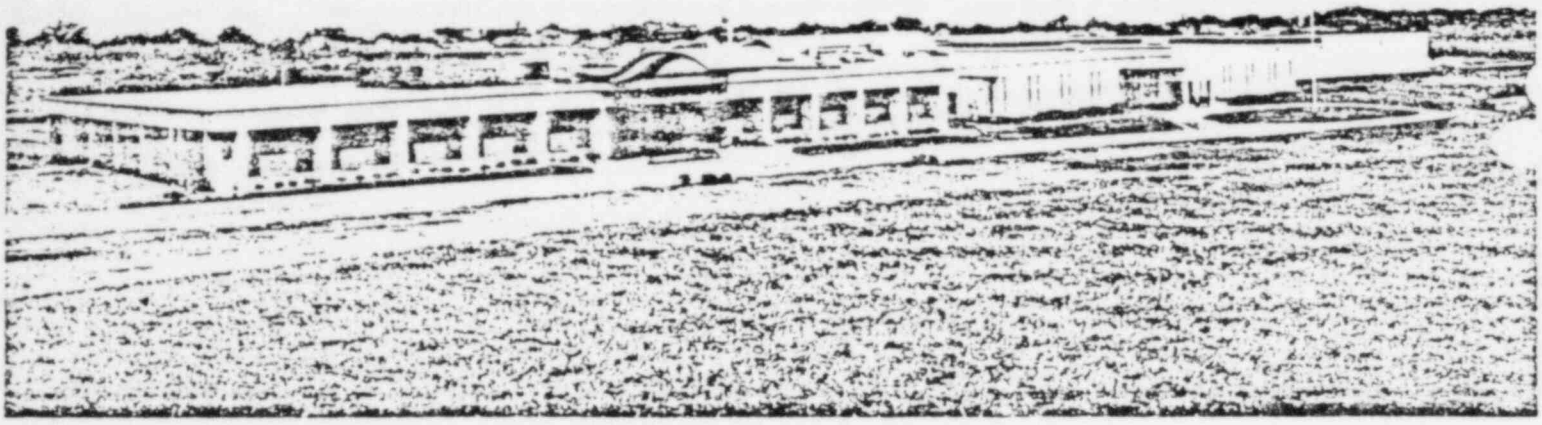
LIMITORQUE
TYPE HBC
INSTRUCTION AND MAINTENANCE MANUAL



A PRODUCT OF LIMITORQUE® CORPORATION



Limitorque Corporation/Lynchburg, Virginia

Your Limitorque Valve Control...

Limitorque is the most advanced valve control on the market. . .the result of many years of constant improvement and development. This booklet has been prepared to help you obtain the most benefit and use from your Limitorque valve controls. It contains instructions on the installation and maintenance of these units, plus helpful suggestions enabling you to become thoroughly familiar with the location and proper use of operating controls. Before you do anything be sure to read this booklet through at least once, then always keep it handy for ready reference.

Limitorque controls the opening and closing travel of the valve and limits the torque and thrust loads with its torque limit switch. As a result all valve operating parts are protected from overload, improper seating and foreign obstructions.

Limitorque controllers may be mounted on any size valve in almost any position or location. Readily adaptable to existing equipment, Limitorque can be actuated by electricity, hydraulic pressure, air or natural gas.

How to Order Parts:

To obtain further information or order parts for your Limitorque Valve Control contact your local representative or write to:

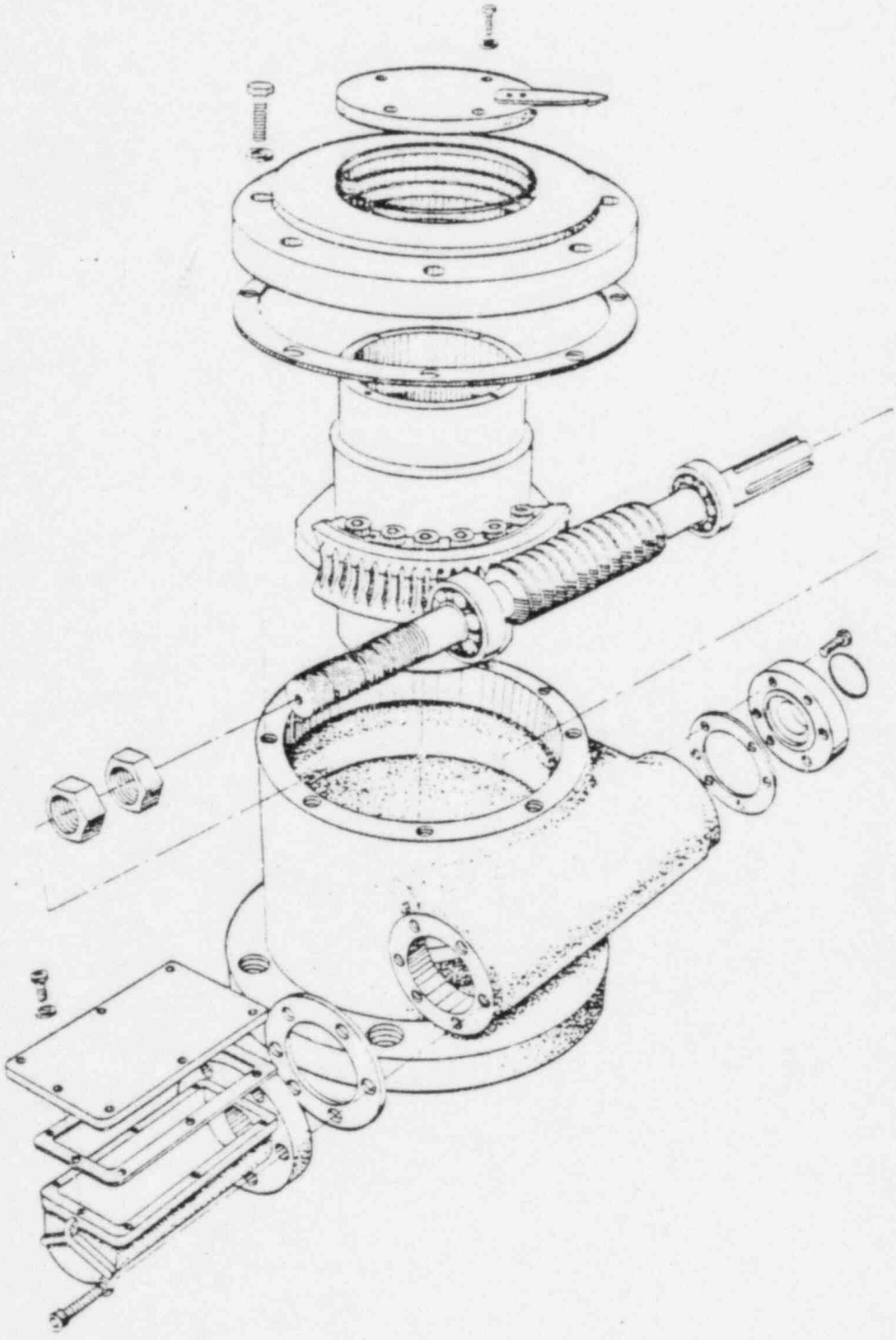
Limitorque Corporation
5114 Woodall Road
Lynchburg, Virginia 24506
Attention: Manager, Parts and Service
(804) 528-4400
Telex 82-9448

All inquiries or orders MUST be accompanied by the following information which can be obtained from the unit name plate.

Unit Size and Type
Serial Number
Limitorque Corporation Order Number

Where to Find Information

A TYPICAL HBC GEAR OPERATOR



INSTALLATION & MOUNTING PROCEDURES

General Instructions

1. Place valve in full closed position.
2. Press splined shaft adapter on valve shaft and insert key. (Should be a press fit to avoid splined adapter movement in HBC drive sleeve.)
3. Remove pointer cap from HBC operator.
4. Turn HBC operator input shaft to full closed position. The stops are preset for 90° travel. Be certain of correct direction of rotation.
5. Mount operator on valve and bolt securely. Be sure of operator stop alignment before engaging splines. (See stop to tolerances on Page 5.)
6. For standard stop setting instructions see below.
7. Units with A.W.W.A. input shaft stop (Refer to Page 10.)

Setting Position Limit Stops HBC-0 thru 3

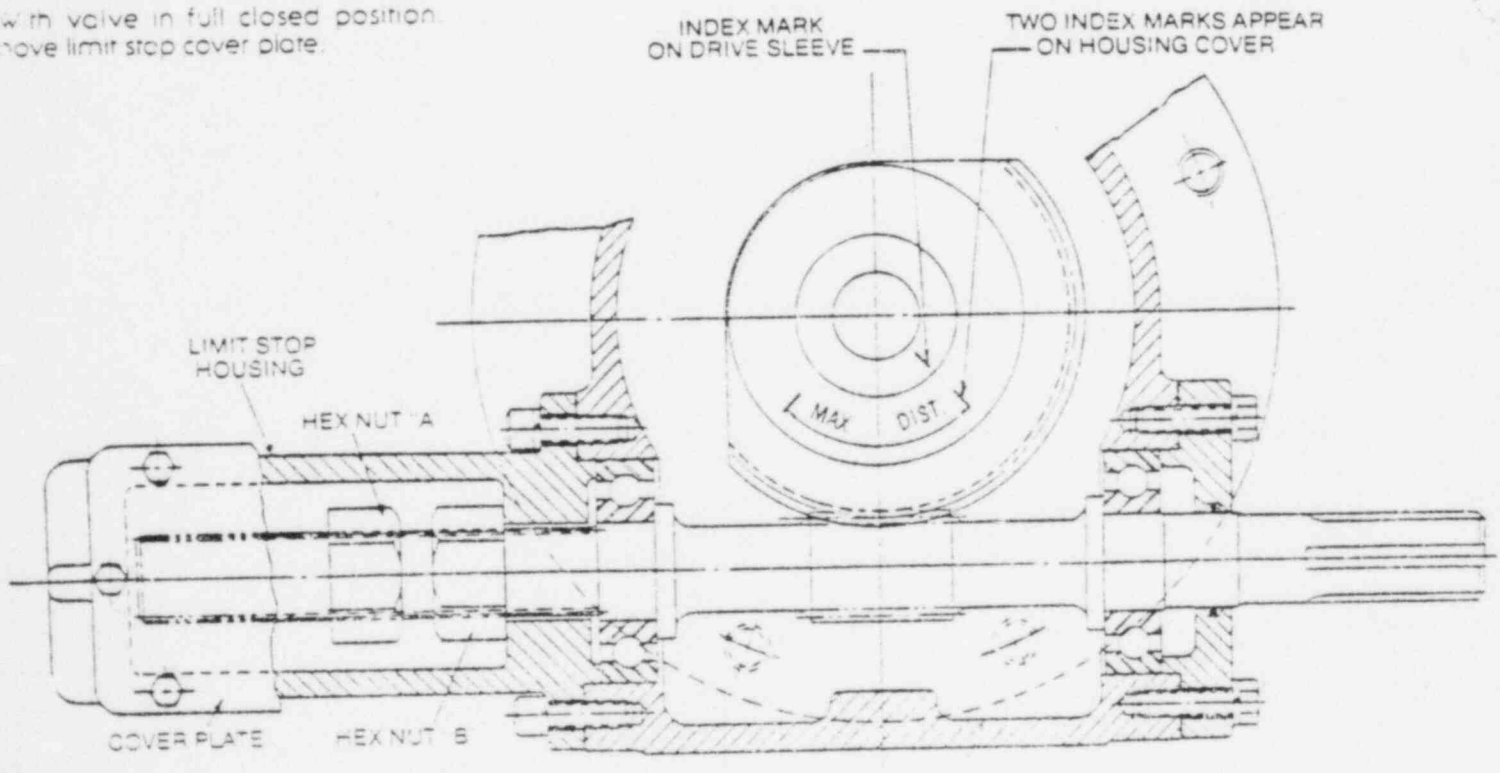
1. With valve in full closed position, remove limit stop cover plate.
2. You will note two traveling hex nuts A & B.
   a) If hex nut B is near the position shown (if hex nut A is near the opposite end of the limit stop housing, proceed with Step 4 first), run the hex nut hand tight against the housing so that one of the flats of the hex nut is on top so as to face the cover plate.
   b) If hex nut A or B hit the housing before the valve was tightly closed, back off the hex nut until the valve is tight and proceed as in (a).
3. Replace the limit stop cover plate and turn input shaft of HBC operator to fully open the valve.
4. Remove limit stop cover plate and check position of hex nut A. This nut should be turned until it is flush up against the end of the limit stop housing and one of the flats of the nut is on top facing the limit stop housing cover plate.
5. Bolt limit stop cover plate in position.

Setting Position Limit Stops HBC-4 thru 10

(See page 7)

1. With the valve in the full closed position, remove stop screw cover (pc #16).
2. Remove lockscrew (pc #17).
3. Adjust appropriate stop screw (pc #17) based on rotation of drive sleeve inward if valve is closed and stop has not yet been reached or outward if stop has been reached and valve is not yet fully closed.
4. Once stop screw is set, lock securely with lockscrew.
5. Operate valve to fully open position and set open stop in same manner.

HEX-NUT TYPE STOP (HBC-0 THRU 3)

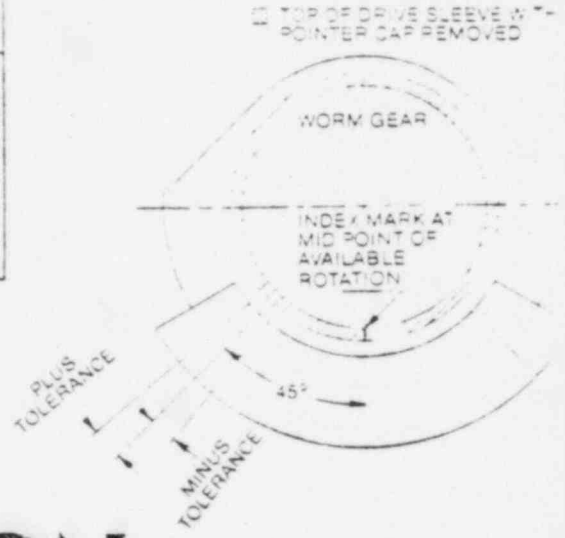


HBC ANGULAR DISPLACEMENT TOLERANCES

UNIT SIZE	ANGULAR DISPLACEMENT STOP	GEAR	SPLINE TOOTH SPACE IN DEGREES
HBC-0	*105°	170° Gear Segment	9.00°
HBC-1	*114°	170° Gear Segment	6.42°
HBC-2	*114°	170° Gear Segment	4.50°
HBC-3	*114°	110° Gear Segment	3.46°
HBC-4	** ±7°	±7°	3.00°
HBC-5	** ±6.75°	±6.75°	2.14°
HBC-6	** ±9°	±9°	1.80°
HBC-7	** ±9°	±9°	N/A
HBC-10	±10%	±10%	N/A

*Stops used on HOBC through H3BC incorporate standard hex nuts. The tolerance listed is ± .031 from basic size on the thickness. The data shown above is based on maximum thickness of both nuts.

**Displacement is based on 45° travel on either side of gear centerline.



LUBRICATION

The Limitorque HBC actuators are shipped with *Nebula EP-0 (Exxon) grease in the unit. This lubricant is suitable for a temperature range of −20°F to 150°F. The lubricant should be checked every 18 months for manual actuators.

The three primary considerations in a lubrication inspection are: (1) Quantity, (2) Quality, and (3) Consistency.

Quantity—Limitorque operators are built to operate on the partial immersion principle. The primary concern in the amount of lubricant is whether the "worm" is totally immersed in grease. This can be verified by the use of one or more of the many "fill" and "drain" plugs provided on the operator housing.

Quality—When removing a "fill" or "drain" plug to inspect the lube level, remove a small amount and insure that it is clean and free of any contaminant including water. Should dirt, water, or other foreign matter be found, the units should be flushed with a commercial degreaser/cleaner like Exxon VARSOL #1 or #0 which is non-corrosive and does not affect seal materials such as Buna N or Viton. Repack unit with fresh lubricant.

Consistency—The main gear box lubricant should be slightly fluid approximating a standard NLGI-1 grade consistency or less. Thinners such as Amoco WAYTAC #31 oil may be added provided the volume of thinner does not exceed 20% of the total lubricant.

Alternate lubricants may be used IN PLACE of the standard lubricants supplied by Limitorque provided they are equivalent to the Nebula EP-0 or P-290 as applicable.

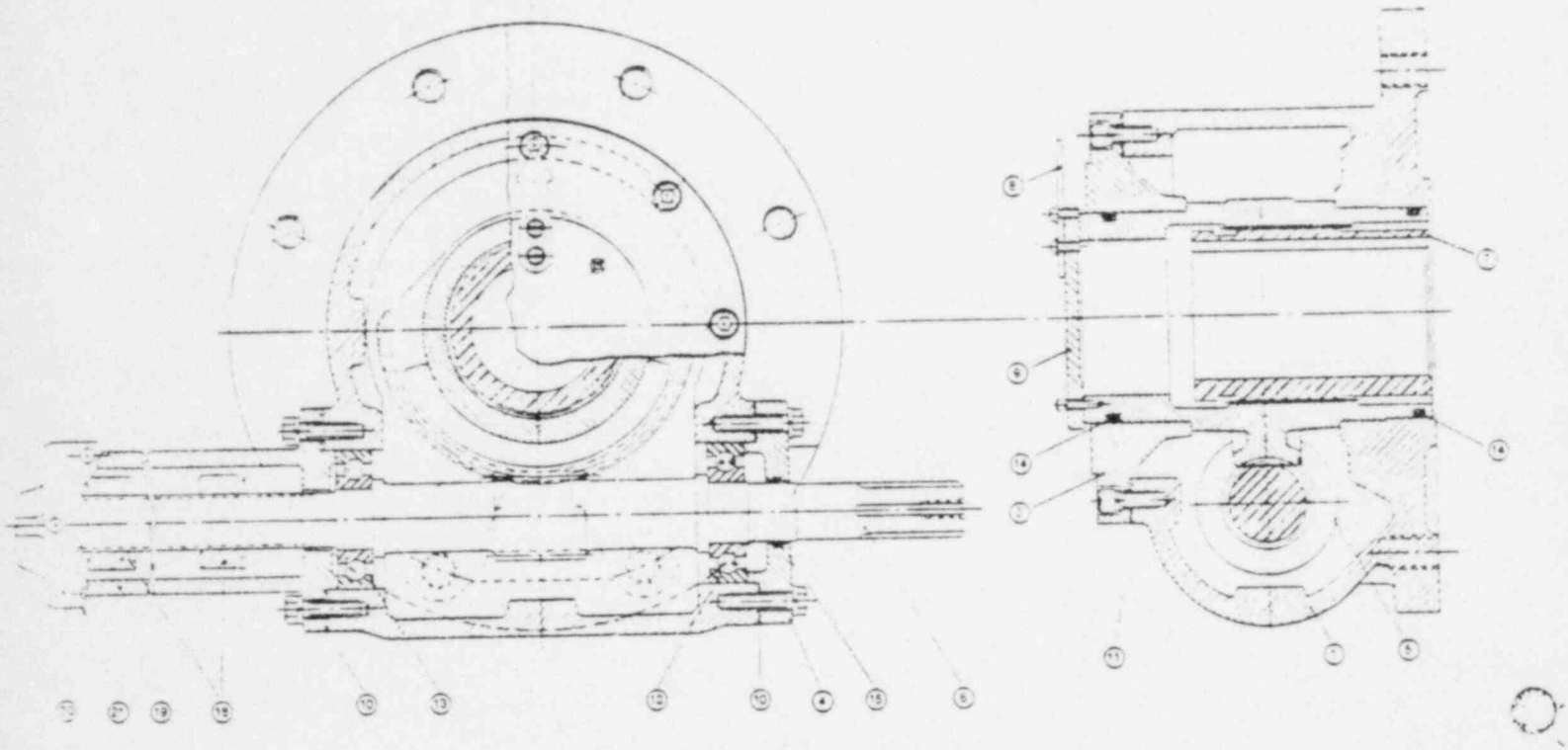
Do not add a different lubricant to a Limitorque operator unless it is of the same soap base as the existing lubricant unless you have received the approval of the lubricant manufacturer.

*For applications with ambient temperatures below −20°F, Limitorque uses Humble P-290 (Exxon).

UNIT SIZE	AMOUNT OF LUBRICANT Approx. Volume (Gallons)	Approx. Weight (Pounds)
HBC-0	.20	1.5
HBC-1	.35	3.0
HBC-2	.50	4.0
HBC-3	1.40	12.0
HBC-4	3.50	30.0
HBC-5	5.20	45.0
HBC-6	9.25	80.0
HBC-7	14.50	125.0
HBC-10	26.00	225.0

Manufacturer	Type	Temperature Range	Base
Exxon	Humble P290	−40°F to 120°F	Lithium Lime
Arco	Litholine HEP1	−10°F to 220°F	Lithium
Gulf Oil	Gulfcrown EP0	−20°F to 220°F	Lithium
Cities Service	City AP	− 0°F to 220°F	Lithium
Mobil Oil Co.	Mobilux EP0	−10°F to 220°F	Lithium 12
Shell Oil	Darina 0	−10°F to 250°F	Hydroxystearate No soap
Fiske	Lubriplate Low Temp	−40°F to 150°F	Lithium
Texaco	Marfak 0	−20°F to 200°F	Sodium
	Low Temp EP	−40°F to 200°F	Lithium
Tidewater Oil	Veedol Alitho 10	−10°F to 150°F	Lithium

DISASSEMBLY INSTRUCTIONS FOR HBC-0 THRU HBC-3

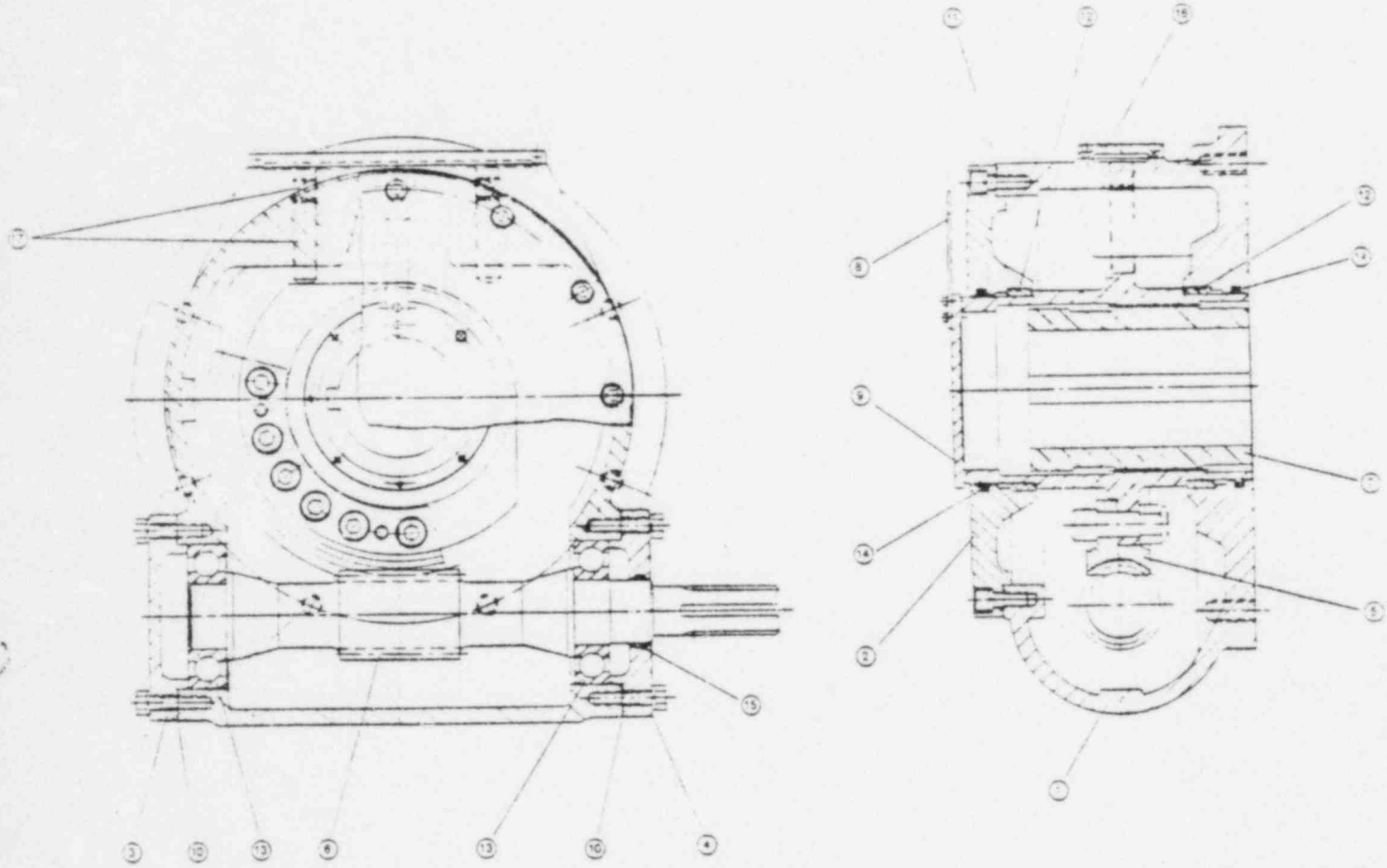


PARTS LIST		
PC. NO. DESCRIPTION	PC. NO. DESCRIPTION	PC. NO. DESCRIPTION
1 HOUSING	8 POINTER	15 WORM SHAFT O RING
2 HOUSING COVER	9 POINTER CAP	16 STOP SCREW COVER
3 END CAP	10 END & THRU CAP GASKET	17 STOP SCREW & LOCKSCREW
4 THRU CAP	11 HSG COVER GASKET	18 HEX STOP NUT
5 DRIVE SLEEVE & WORM GEAR	12 DRIVE SLEEVE BUSHING	19 LIMIT STOP HOUSING
6 WORM SHAFT	13 WORM SHAFT BEARING	20 CAP LIMIT STOP HSG
7 SPLINE ADAPTER	14 DRIVE SLEEVE O RING	21 LIMIT STOP HSG GASKET

1. Remove limit stop housing cap, pc #20 and gasket pc # 21
2. Rotate worm shaft, pc #6, clockwise until pointer cap, pc #9, stops rotating.
3. Remove pointer cap, pc #9, and housing cover, pc #2.
4. Remove both stop nuts, pc #18, and limit stop housing, pc #19.
5. Remove thru cap, pc #4.
6. Remove worm shaft, pc #6 by pulling from housing, pc #1. It may be necessary to work bearing, pc #13, around drive sleeve, pc #5, by rotating the drive sleeve slightly in the direction it was turning in Step #2. It is not necessary to remove bearing, pc #13, from worm shaft.

In reassembling the above unit follow all of the above steps in the reverse order. Be sure you have located the center line of the sector gear before reinstalling the housing cover, pc #2.

DISASSEMBLY INSTRUCTIONS FOR HBC-4 THRU HBC-10



PARTS LIST					
PC. NO.	DESCRIPTION	PC. NO.	DESCRIPTION	PC. NO.	DESCRIPTION
1	HOUSING	8	POINTER	15	WORM SHAFT "O" RING
2	HOUSING COVER	9	POINTER CAP	16	STOP SCREW COVER
3	END CAP	10	END & THRU CAP GASKET	17	STOP SCREW & LOCKSCREW
4	THRU CAP	11	HSG. COVER GASKET		
5	DRIVE SLEEVE & WORM GEAR	12	DRIVE SLEEVE BUSHING		
6	WORM SHAFT	13	WORM SHAFT BEARING		
7	SPLINE ADAPTER	14	DRIVE SLEEVE "O" RING		

1. Remove stop screw cover piece, pc #16.
2. Remove stop screw and lock screw (total 2 each), pc #17.
3. Rotate worm shaft full clockwise until pointer cap, pc #9, stops rotating or until the worm shaft can no longer be turned.
4. Remove end cap, pc #3, and thru cap, pc #4.
5. Remove pointer cap, pc #9, and housing cover, pc #2.
6. Remove worm shaft, pc #6, by pulling from housing, pc #1. It will be necessary to slightly rotate or cock the drive sleeve, pc #5, away from the worm in order to allow the bearing, pc #13, to clear. It is not necessary to remove the bearing, pc #13, from the worm shaft.

To reassemble the actuator, proceed in the reverse order listed above. In order to insure good stop nut engagement at the end of travel, it is recommended that the stops be preset for 90° of rotation by establishing 45° rotation on either side of the worm gear center line while installing the stop screws. It will then be necessary to re-adjust the stops once the actuator is on the valve, however, this will minimize the risk of disorienting the worm gear sector.

DISASSEMBLY INSTRUCTIONS FOR SPUR & BEVEL GEAR ATTACHMENTS

All of the standard Limitorque spur gear attachments are made up of segments. The first segment is the 2.86:1 attachment. When the second segment is added to the first, the overall attachment ratio increases to between 8.5 and 12:1. When both the first and second attachment are added to the third, the overall gear ratio is between 19 and 38.9. The disassembly instructions described below will disassemble the 38.9:1 attachment. Steps 1 thru 5 describe the 2.86:1 disassembly. Steps 1 thru 10 describe the 8.5 to 12:1 attachment disassembly and the full instruction describes the 19 to 38.9:1 attachment disassembly.

1. Remove the [illegible] housing, pc #2.
2. Remove idler shaft and pinion, pc #3.
3. Remove idler gear, pc #4, and idler gear spacer, pc #8.
4. Remove first set output gear, pc #5.
5. If only 2.86:1 spur attachment was utilized you must next remove housing adapter, pc #1, and output gear spacer pc #7.
6. Remove second set housing adapter pc #20.
7. Remove intermediate shaft and pinion, pc #22, being careful not to lose thrust washers, pcs #27 and 28.
8. Remove output gear collar, pc #25.
9. Remove second set output gear, pc #23, and second set output gear spacer pc #24.
10. If the spur attachment gear ratio is 8.5 to 12:1, next remove second set housing, pc #19.
11. If the spur attachment ratio was 19 to 38.9:1, remove third set housing adapter, pc #32.
12. Remove intermediate shaft and output pinion, pc #33, being careful not to lose thrust washers, pcs #37 and 38.
13. Remove third set output gear collar, pc #35.
14. Remove third set output gear, pc #34, and spacer, pc #36.
15. Remove third set housing, pc #31.

In reassembling the above spur attachments, follow all of the instructions in the reverse order, ensuring that all of the bearings indicated in assembly drawings are intact and in good condition.

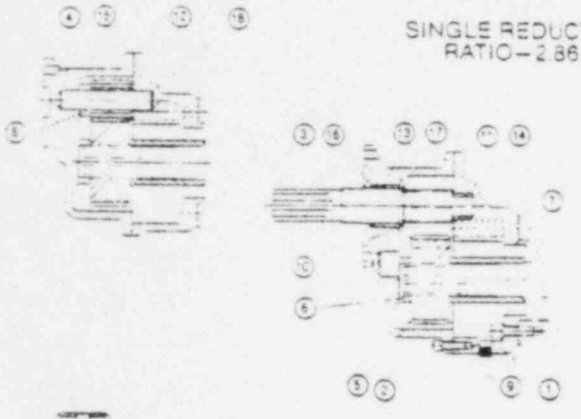
Bevel gear attachments of all ratios utilize a basic 2.86:1 input bevel gear attachment to replace the basic 2.86:1 first set spur attachments and then all remaining gear ratios are identical to that listed above. For disassembly of the first set 2.86:1 bevel, proceed as follows:

1. Remove bevel gear housing cap, pc #43.
2. Remove bevel pinion and shaft, pc #44.
3. Remove bevel gear housing, pc #42.
4. Remove bevel gear, pc #45, and spacer, pc #7.
5. If the attachment gear ratio was 2.86:1, remove pc #1, first set housing adapter.
6. If the attachment was greater than 2.86:1, proceed as above starting with Step 6.

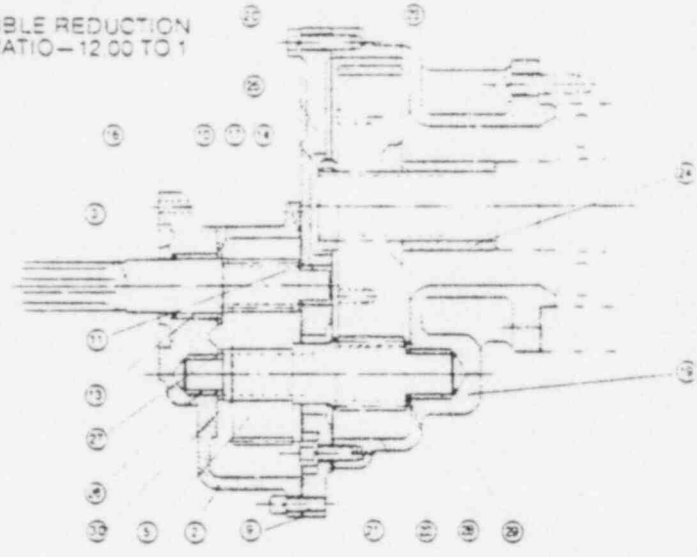
NOTE: When replacing gaskets, use gasket thickness of 1/32".

DISASSEMBLY INSTRUCTIONS FOR SPUR & BEVEL GEAR ATTACHMENTS

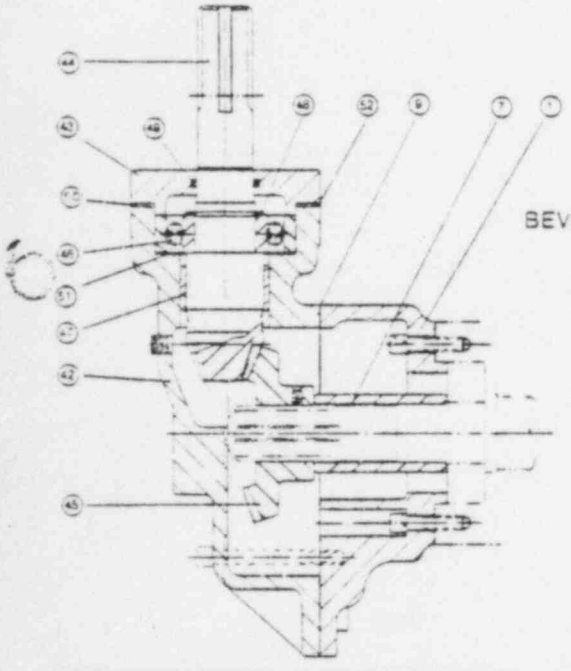
SINGLE REDUCTION
RATIO – 2.86 TO 1



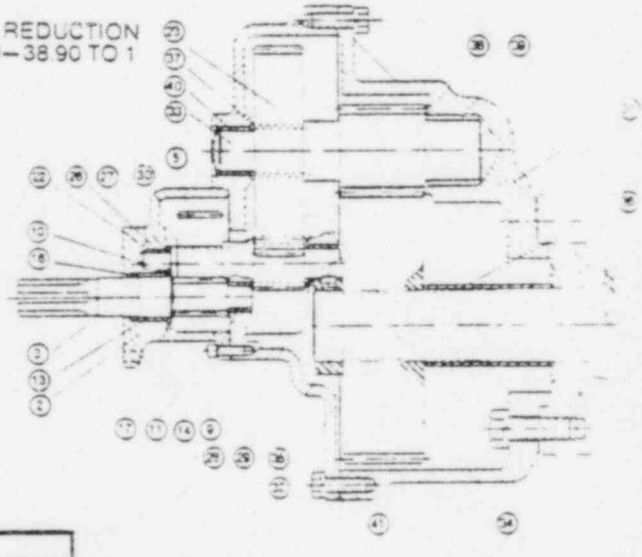
DOUBLE REDUCTION
RATIO – 12.00 TO 1



BEVEL GEAR REDUCTION
RATIO – 2.86 TO 1



TRIPLE REDUCTION
RATIO – 38.90 TO 1



PARTS LIST

PC. NO.	DESCRIPTION
1	1ST SET HOUSING ADAPTER
2	1ST SET HOUSING
3	1ST INPUT SHAFT & PINION
4	IDLER GEAR
5	1ST SET OUTPUT GEAR
6	1ST SET COLLAR
7	1ST SET OUTPUT GEAR SPACER
8	IDLER GEAR SPACER
9	1ST SET HOUSING GASKET
10	THRUST BRG. INPUT SHAFT
11	THRUST BRG. INPUT SHAFT
12	THRUST BRG. IDLER GEAR
13	BEARING 1ST SET HSG.
14	BEARING 1ST HSG. ADAPTER
15	BEARING IDLER GEAR
16	QUAD RING INPUT SHAFT
17	RETAINING RING INPUT SHAFT
18	IDLER SHAFT PIN

PC. NO.	DESCRIPTION
19	2ND SET HOUSING
20	2ND SET HOUSING ADAPTER
21	2ND HSG. GASKET
22	INTERM. SHAFT & PINION
23	2ND SET OUTPUT GEAR
24	2ND SET OUTPUT SHAFT SPACER
25	COLLAR OUTPUT GEAR 2ND SET
26	BEARING INTERM. SHAFT
27	THRUST BRG. INTERM. SHAFT
28	THRUST BRG. INTERM. SHAFT
29	BEARING 2ND SET HOUSING
30	INTERM. SHAFT RETAINING RING
31	3RD SET HOUSING
32	3RD SET HSG. ADAPTER
33	INTERM. SHAFT & OUTPUT PINION
34	3RD OUTPUT GEAR
35	COLLAR OUTPUT GEAR 3RD SET
36	3RD SET OUTPUT SHAFT SPACER

PC. NO.	DESCRIPTION
37	THRUST BRG. OUTPUT PIN & SHAFT
38	THRUST BRG. OUTPUT PIN & SHAFT
39	BRG. 3RD SET HOUSING
40	BRG. 3RD SET HSG. ADAPTER
41	3RD SET HSG. GASKET
42	BEVEL GEAR HOUSING
43	B. G. HSG. CAP
44	BEVEL PINION & SHAFT
45	BEVEL GEAR
46	PINION SHAFT BEARING
47	PINION SHAFT BUSHING
48	BEVEL PINION RETAINING RING
49	B. G. CAP O. RING
50	B. G. CAP GASKET
51	PINION SHAFT BRG. SHIM
52	PINION SHAFT CAP SHIM

SETTING INSTRUCTIONS FOR AWWA INPUT SHAFT STOP

1. Refer to parts drawing Figures A, B, C & D
2. Remove cover plates, pc #9, #10 and #11
3. Note the position of the racks, pc #19. The racks should be in the up position as shown in Figure A.
4. Note the position of the three (3) center punch marks on the end of the input shaft, pc #4. These center punch marks show the position of the lug on the lug sleeve, Item No. 5.
5. With the input shaft as shown in Figure A, pull the idler gear, pc #18, and hold it out of engagement with the input pinion, pc #17.
6. Rotate the handwheel on the input shaft clockwise until the valve reaches the extreme position of travel. With a normally clockwise handwheel rotation to close, the valve will go to the full closed position. If the valve is clockwise handwheel rotation to open, the valve will go to the full open position.
7. Place the input shaft in position as shown in Figure C.
8. Using a screwdriver, rotate the input pinion, pc #25 A, as shown in Figure B, clockwise until the rack, pc #19 A, moves downward as shown in Figure C. Do not rotate the pinion any further.
9. Push idler gear, pc #18, into engagement and rotate input shaft clockwise to check the setting. The lug should hit the rack and prevent further handwheel rotation.
10. Hold the idler gear, pc #18, engaged with the input pinion and rotate the input shaft, pc #4, counter-clockwise to the other extreme valve position. Do not allow the idler gear to come out of engagement. If the rack, pc #19 B, should trip to the down position as shown in Figure D, before the valve reaches the extreme position of travel, turn the input shaft back one turn, pull out of engagement, pc #18, place a screwdriver on the input pinion, pc #25 B, and rotate clockwise approximately 50 turns. Push idler gear, pc #18, into engagement again and rotate handwheel counter-clockwise until the valve goes to the extreme position of travel. Repeat as necessary until the valve reaches the point where the stop should be set.
11. With the valve in the position to be set, position the input shaft as shown in Figure D and with the screwdriver on pc #25 B, rotate the input pinion counter-clockwise until the rack, pc #19 B, moves as shown in Figure D. Do not rotate the pinion any further.
12. Push idler gear, pc #18, into engagement and rotate input shaft counter-clockwise to check seting. The lug should hit the rack.
13. Reassemble covers, pc #9, #10 and #11.
14. Open and close the valve fully to be certain position limit stops are set at the desired valve position.

CAUTION: Following these instructions exactly will prevent jamming or damaging the equipment.

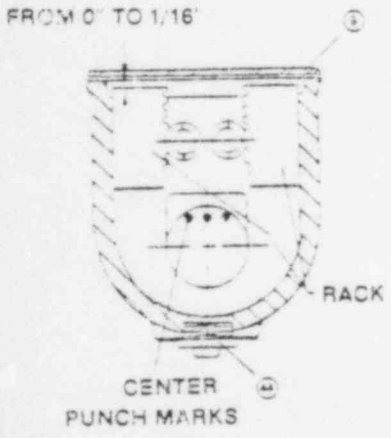


FIG. A

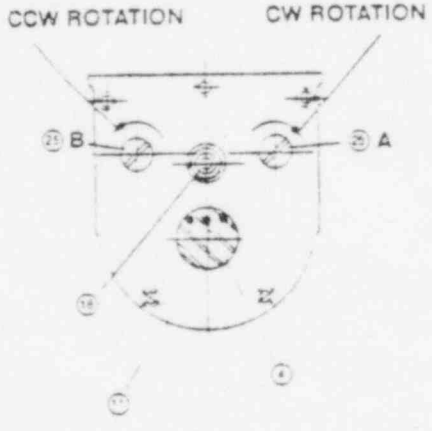


FIG. B

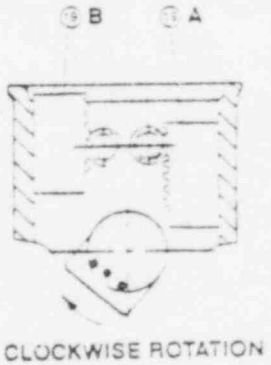


FIG. C

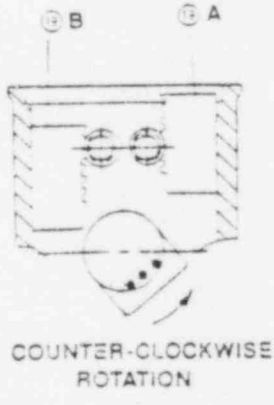
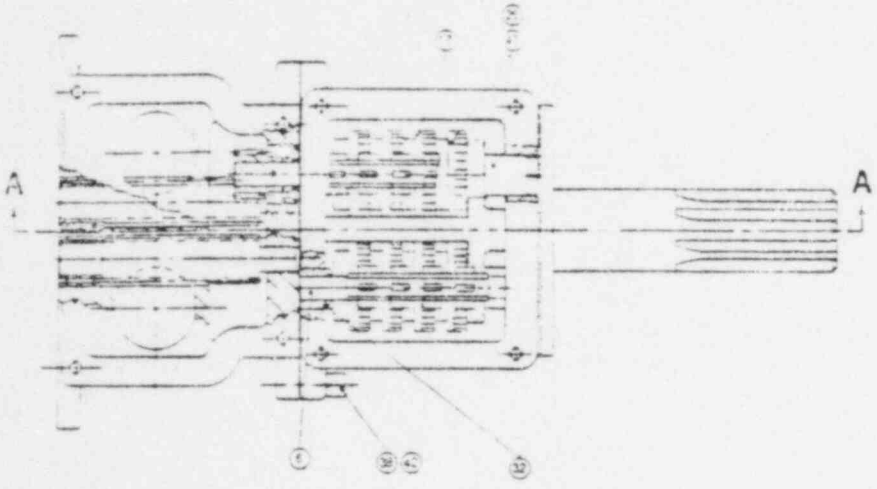


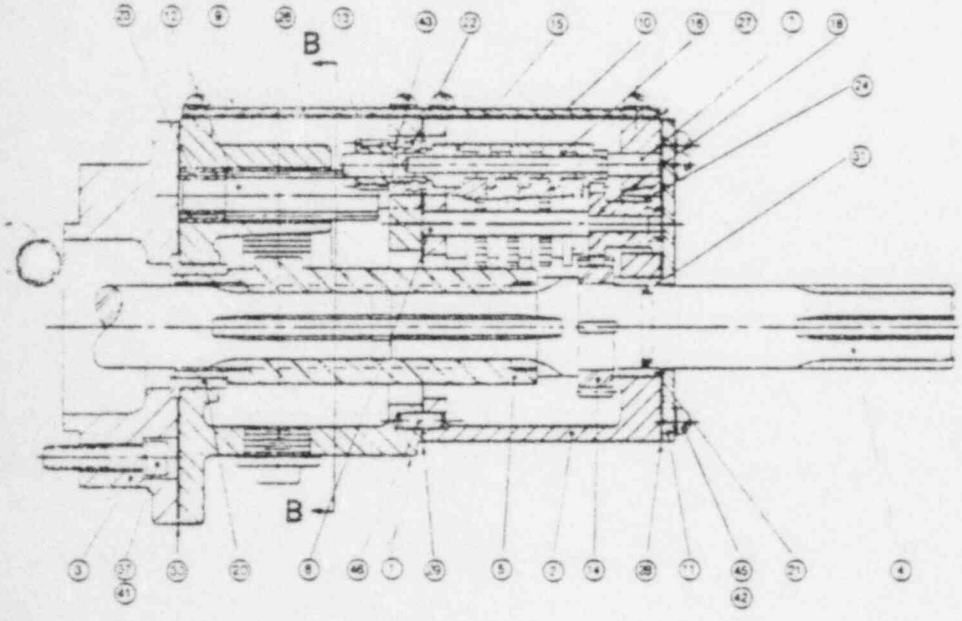
FIG. D

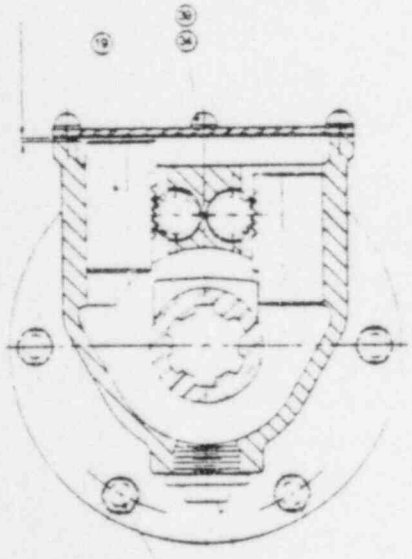
AWWA INPUT SHAFT STOP

PATENTED

*COMPLIES FULLY WITH
AWWA SPEC NO C504-70



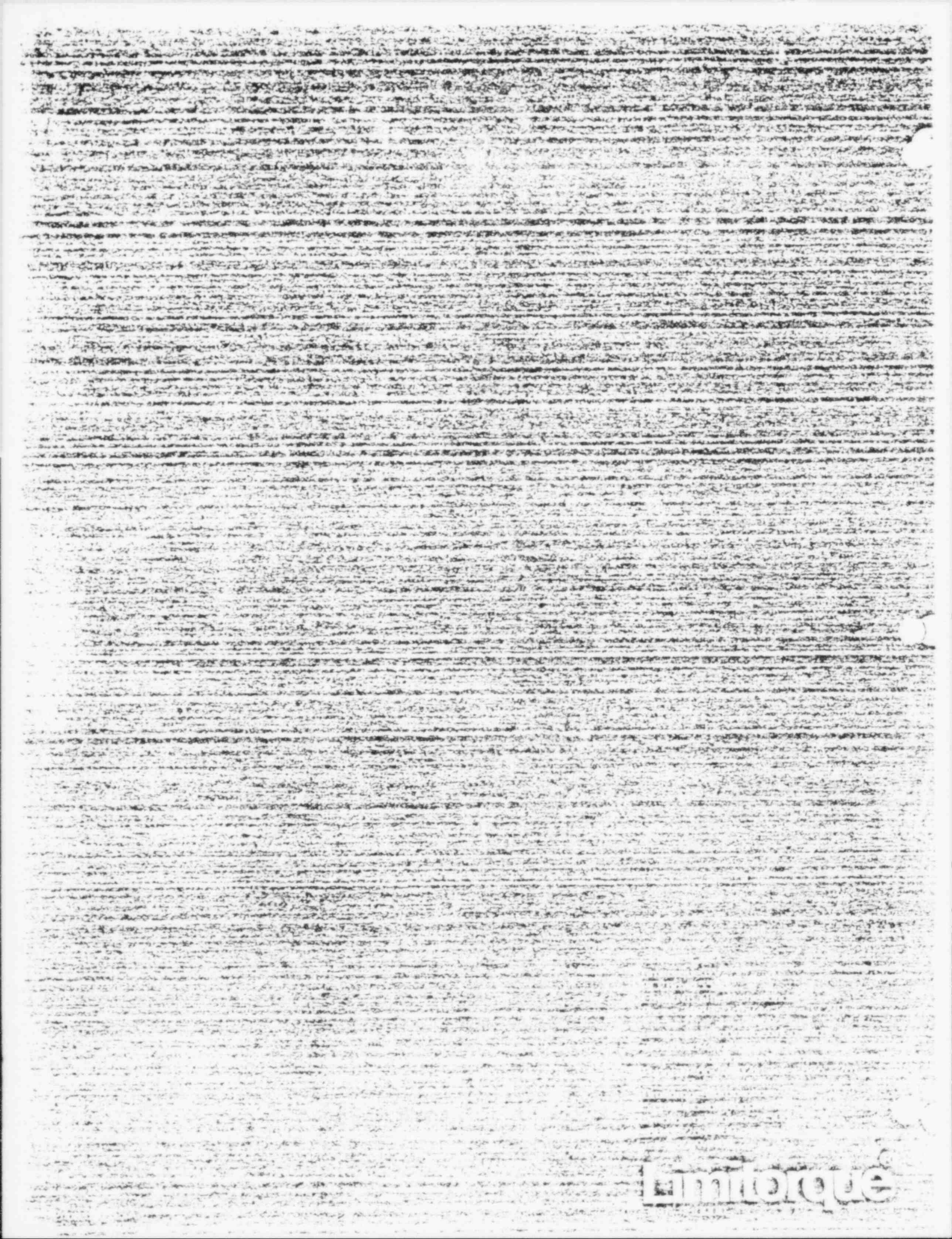




When the AWWA input shaft stop is used the standard limit stop is also furnished.

PARTS LIST

PC No	DESCRIPTION
1	LIMIT STOP HOUSING
2	GEAR FRAME
3	LIMIT STOP HSG. ADAPTER
4	INPUT SHAFT
5	SPLINED-LUG SLEEVE
6	INTERMITTENT GEAR SHAFT
7	INTERMITTENT PINION SHAFT
8	INTERMITTENT DRIVE SHAFT
9	COVER (LIMIT STOP HSG.)
10	COVER (GEAR FRAME HSG.)
11	GEAR FRAME THRU CAP
12	RACK PINION
13	PINION
14	INPUT GEAR
15	INTERMITTENT STEM PINION
16	INTERMITTENT PINION
17	INTERMITTENT GEAR
18	IDLER GEAR
19	RACK
20	FLANGED BUSHING
21	INPUT SHAFT BUSHING
22	INTERMITTENT STEM PINION BRG
23	RACK PINION BEARING
24	BUSHING
25	INPUT PINION
26	HOUSING COVER GASKET
27	GEAR FRAME COVER GASKET
28	THRU CAP GASKET
29	HOUSING GASKET
30	ADAPTER GASKET
31	O RING
32	BUSHING
34	CAP SCREW RD HD #10-32 x ½" LG
35	ROLL PIN ¼" DIA x ¾" LG
36	CAP SCREW HEX HD ⅜-16 x 1" LG
37	CAP SCREW SOC HD ¼-16 x 1" LG
38	CAP SCREW SOC HD ¼-20 x ¾" LG
39	LOCKWASHER #10
40	LOCKWASHER ¼"
41	LOCKWASHER ⅜"
42	LOCKWASHER ½"
43	ROLL PIN ⅛" DIA x ⅝" LG
44	1"-20 DRAIN PLUG
45	CAP SCREW RD HD ¼-20 x 1" LG
46	DOWEL PIN ⅛" DIA x ⅝" LG
47	INPUT PINION-GEAR ASSY



LIMITORQUE MOTORS

BULLETIN LM-77

Prepared by
LIMITORQUE CORPORATION

The application of motor actuators to valves requires unique performance characteristics from both the actuator and the motor. There are numerous approaches to actuator design; however, all motor designs for valve actuator service must have a number of common characteristics.

The force (thrust or torque) required to operate a valve is not totally predictable. There are many philosophies regarding the equations used to determine the force (thrust or torque) required to seat/unseat or stroke a valve. Each valve design can have a distinct set of load characteristics entirely different from other valves in the same general family, or similar types or designs even within the same valve manufacturer.

The following data represents typical operating criteria for a valve actuator and how this data should be used in the motor design.

GATE AND GLOBE VALVE REQUIREMENTS

Seating/Unseating

All formulae currently used by gate and globe valve manufacturers in determining the forces required to operate their valves are centered around seating or unseating the gate or plug against a differential pressure. This seating/unseating force usually occurs in the last few turns of the actuator (or first few turns in unseating) and reaches its maximum in 50 to 2000 milliseconds depending on the speed of operation and the rigidity of the valve.

The seating/unseating force requires the most torque out of the valve actuator motor (see Figure 1). Because of the very short time this force is experienced as compared to the total stroke time. Limitorque uses the "stall torque" or "starting torque" potential of the motor (less a safety factor) to produce it. This means that motor amperage may approach its locked rotor value while seating or unseating a valve.

RUNNING

While stroking a valve, the only two forces present are the stuffing box load and the stem piston differential effect (stem area x line pressure) with the latter being the only predictable force.

The stem piston differential effect is an additive force to the stuffing box load in the closing direction and a negative force in the opening direction. The motor running torque capability must adequately handle the combination of the stuffing box load and the stem piston effect.

Experience and valve manufacturers data show that the stroking force, (average of opening and closing a gate or globe valve), is approximately 20% to 40% of the seating force in the overwhelming number of applications (see Figure 1). When this load (20% to 40% of seating) is reflected back to the motor, it represents 10% to 25% of the seating load due to the increase of the actuator dynamic efficiency as opposed to starting or static efficiency. The motor should therefore, be adequate to accommodate a running torque of 10% to 25% of the seating force (torque).

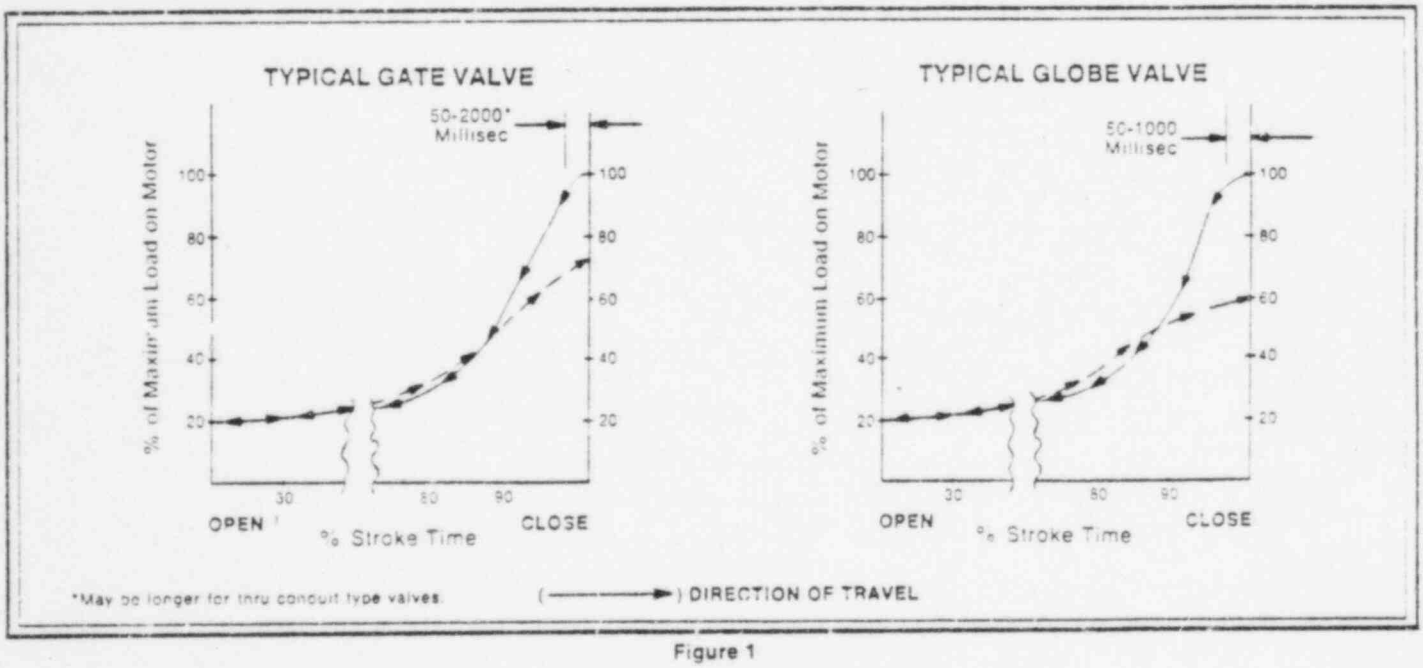


Figure 1

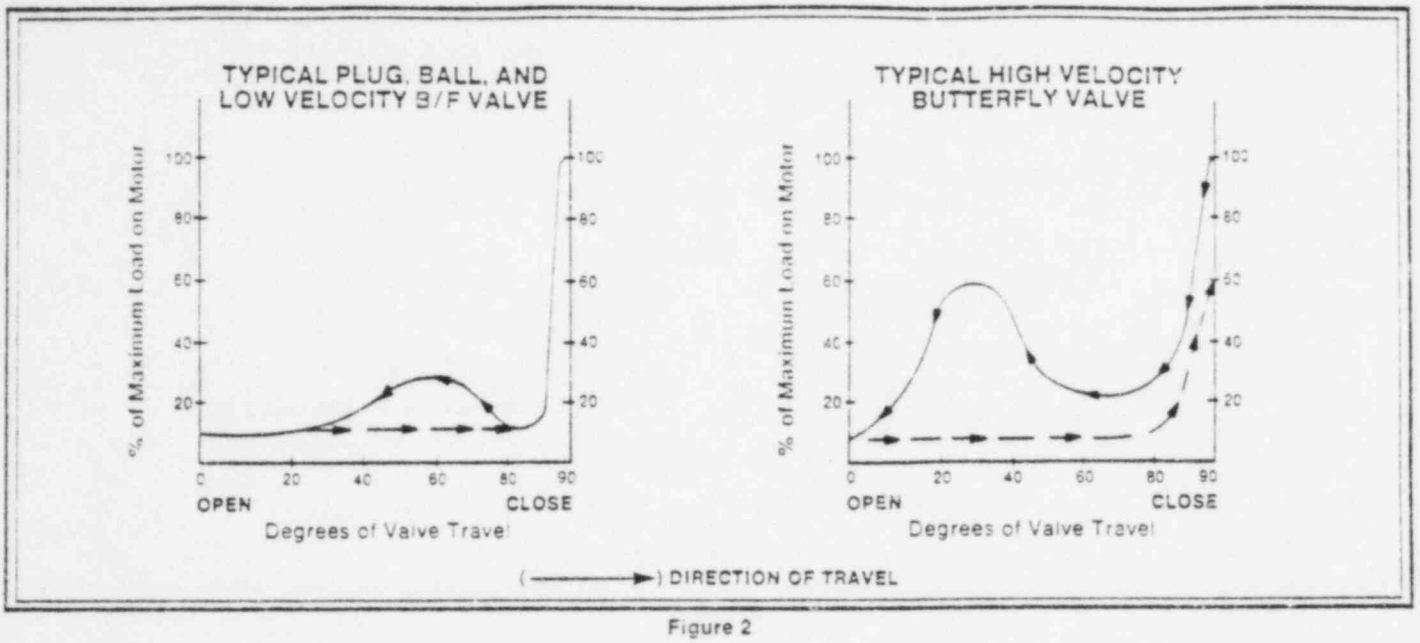


Figure 2

BUTTERFLY, BALL, AND PLUG VALVE REQUIREMENTS

The tailoring of motor designs to butterfly, ball, and plug valves is a bit easier as the running torques for these valve designs are more predictable than in gate and globe valve applications.

The seating or unseating forces in a butterfly, ball, or plug valve are composed of a bearing friction and a force proportional to the shutoff pressure and leakage rate allowed, whereas the running load is proportional to the flow rate and disc design. The majority of butterfly valve applications fall into the same class as the gate and globe valves where the average running torque is approximately 20% to 40% of the normal seating/unseating torque (see Figure 2). This actuator running load, when reflected at the motor, again represents 10% to 25% of the seating load due to the increase in unit efficiency while running.

Because of the unique flow characteristics of "high velocity" butterfly valves, e.g., circulating water applications or those located in turbulent flow areas, the running torque requirements may be as great or even greater than the seating torque. In applications such as these, it is not uncommon to witness motor current draws approaching 200% to 250% of nameplate for a short period of time while stroking a butterfly valve through its peak torque requirement (between 20% and 75% open) when a standard running torque rated motor is used. This momentary load is of no consequence on applications with stroking times of five minutes or less as the "average" load the motor experiences is well within its capabilities. For "high velocity" applications with stroke times longer than five minutes, motor capacity should be verified.

MOTOR DESIGN EVALUATION

The preceding data indicates that a theoretical motor torque is required to seat or unseat a valve and that an average of approximately 10% to 25% of the seating/unseating torque is needed throughout the stroke. With this as a basis for performance, we can determine the physical (frame) requirements best suited for valve actuator service.

Inertia/Frame Size

All motor-operated valves rely on finitely set limit or torque switches to de-energize the motor at a given position or torque level. Any additional overtravel or load developed due to inertia **must** be kept to a minimum. Additional forces due to inertia, which are over and above the normal required seating forces, can cause premature valve wear and, possibly, valve damage. By keeping the motor frame size as small as possible, consistent with good design, inertia is kept as low as possible.

Duty Rating/Frame Size

Recognizing the usual short stroke times (less than two minutes) on most motor actuator applications, a short time rating of the motor is selected to minimize frame size and inertia and yet maximize useability which would enable motors of the same torque and duty rating to be used interchangeably—regardless of application and service. This gives both Limitorque and its customer the advantage of one family of torque and duty rated motors for the vast majority of applications.

Heavy duty valve actuators of the Limitorque type are generally used in areas where three-phase A.C. power is readily available. The optimum combination of motor frame sizes for three-phase motors occurs with a 15-minute duty rating. When using single phase and D.C., the best combination of motor frame sizes occurs with a 5-minute duty rating.

Frame Design

Most customers prefer to have their motors serviced by local repair shops; therefore, standard Nema frame sizes are used. This frame should be TOTALLY ENCLOSED for both indoor and outdoor applications, and NON-VENTILATED (for the usual short stroke time applications) to minimize inertia. (A fan would be useless for short time ratings and it would increase the motor inertia. Motor frames are designed in accordance with Nema MG1-1.26A & E (Nema IV) for indoor and outdoor applications (weatherproof) and Nema MG1-1.26A & C (Nema VII) for explosion-proof service.

Insulation System

The current industry standard for motor insulation is Nema Class "B" with a maximum continuous temperature rating of 120° C (rise — ambient). The rated service factor for special purpose motors such as those used on valve actuators should be 1.0 as there is no uniform condition which could be used as a base for any other service factor.

There is an inherent service factor built into the motor design rating by virtue of its required duty compared to its duty rating. This inherent service factor is described by the following equation:

$$\frac{\text{DUTY RATING}}{\text{OPERATING TIME}} = \text{inherent service factor}$$

The use of special insulation systems such as Nema Class "F" or "H" is not recommended unless the service conditions are beyond the range of the standard Class "B" system. Special insulation systems add to the initial cost and lead time without adding appreciable safety factor to the motor design.

Any insulation system used by Limitorque has an inherent safety factor computed in the same manner as the motor service factor.

Motor Design

The ideal motor which meets all of the above criteria is:

Starting torque rated
Rated Running Torque = approximately 20% of starting torque
Rated Service Factor = 1.0
Standard Insulation = Class "B"
*Rated Running Time @ Rated Running Torque is 15 minutes for 3-phase; 5 minutes for D.C. and single phase.
**Standard Nema TENV Frame Size

*Without exceeding Nema allowable temperature rises for the insulation system used.
**Limitorque motors are supplied in standard Nema frame sizes but are equipped with modified flange and shaft for mounting purposes.

Proper Motor Selection

In applying the above motor, Limitorque ensures that:

(1) The application never requires more starting torque than the motor has available.

(2) The motor will stroke the valve at least open and close without exceeding its safe thermal rating.

(3) The motor will stroke the valve when the motor terminal voltage is ±10% of the required rating (unless otherwise specified; e.g., most nuclear safety-related specs call for +10%, −20%).

When reviewing the running torque requirements, Limitorque cannot ensure that the actual running loads on the motor are always less than the 20% rated running torque listed on the nameplate (which represents an average running condition), but rather that the motor will absolutely stroke the valve for the specified number of times. It must **ALWAYS** be kept in mind that the 20% rated running torque is available for at least rated running time of 15 minutes for A.C., and 5 minutes for D.C. and single phase. This same motor can be used for much higher running loads (over 20%) for equal or shorter running time ratings provided the Nema insulation rating is not exceeded. The motor performance curve is used by Limitorque to ensure that the Nema temperature requirements are maintained at running loads over the standard 20% rated.

Limitorque motors are specifically designed for valve operator service. The speed/torque curves are prepared by the Limitorque engineering staff who then approves the frame size and duty rating. Most Limitorque motors have ample thermal capacity to operate at twice the standard 20% rated running torque listed on the nameplate for periods of five to fifteen minutes (see Figure 3). These motors are applied per the Limitorque standard Selection Procedure which includes the appropriate safety factor requirements.

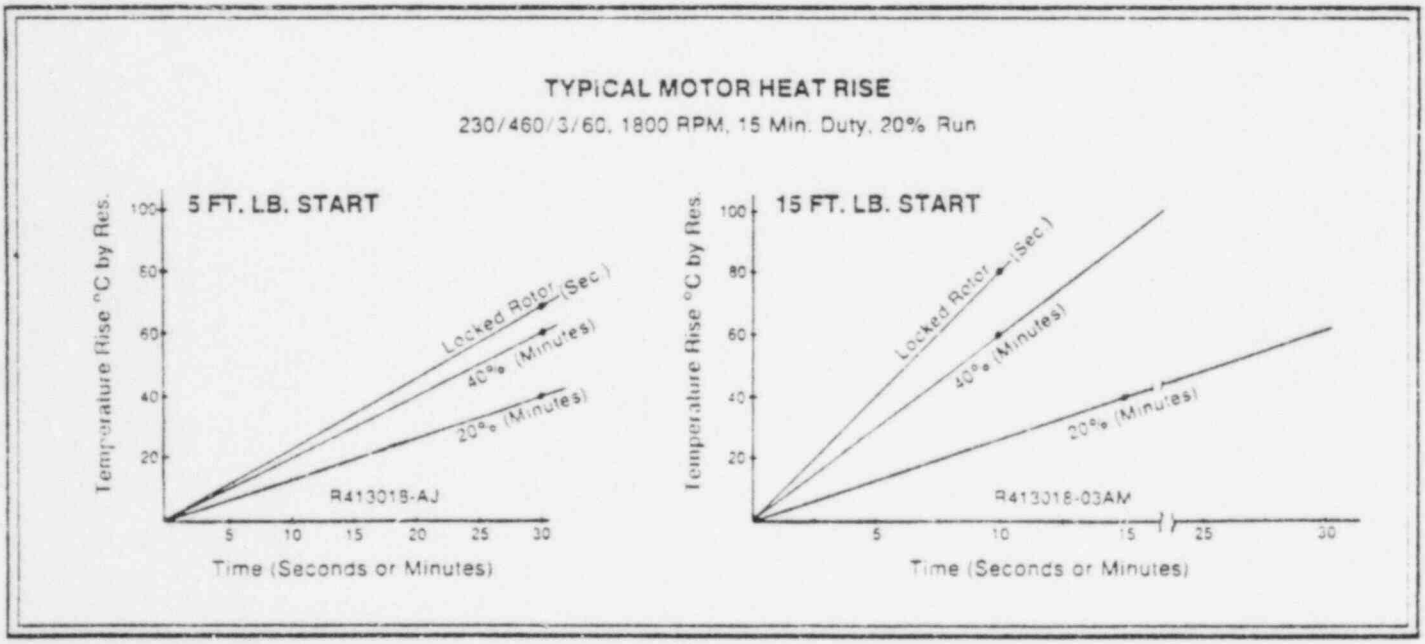


Figure 3

SELECTING OVERLOAD PROTECTION

The standard thermal overload relay, if selected by routine commercial methods, will **not** adequately protect a short time duty rated motor primarily because it was designed for motors used in continuous duty applications and not applications which have run times of five seconds to two minutes such as commonly found on valve actuators.

To select a thermal overload relay, one must look at the stroke time for the application and protect the motor accordingly. Usually, the best method for selecting a thermal overload is to ensure that the motor will trip the overload device while at locked rotor current within ten seconds for A.C. (3-phase) and eight seconds for D.C. and single phase.

There are "quick trip" overload relays commercially available which are ideal for valve actuator motors. These overloads allow the motor to run at nameplate (rated full load) current indefinitely, however, they will trip within five seconds at locked rotor current (usually 600% to 800% of nameplate full load current).

Built-in motor thermal contacts are not a dependable means of protecting medium and large valve actuator motors. Most actuator motors fail because the motor has been stalled too long or too often. Motor winding hot spots develop under a stalled condition and these hot spots cannot be handled adequately by motor thermal contacts, especially if less than three (for 3-phase) are used. Motor rotors (which are the center of the heat build-up under stalled conditions) receive maximum protection from a current sensitive overload device, such as a "quick trip" or correctly selected "bi-metallic" overload relay.

Thermal contacts are designed to be very small to allow them to fit into the motor windings. This miniaturizing detracts from the ruggedness and dependability of the thermal contact. The fact that they are imbedded in the motor windings makes them impossible to maintain or service without rewinding the motor which also detracts from their acceptability.

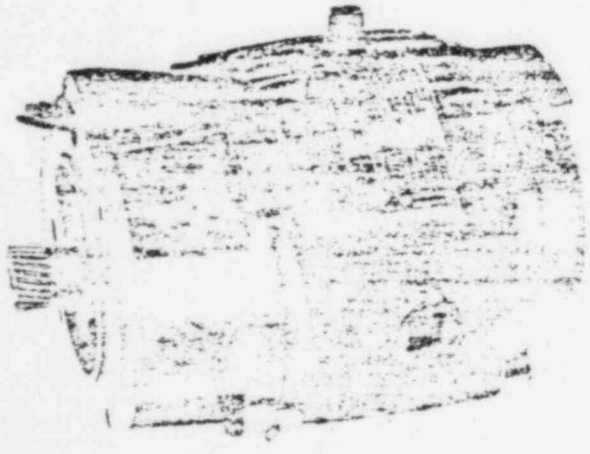
Limitorque motors are designed to operate at higher than nameplate voltage. A high voltage will cause the full load nameplate current to rise due to the saturation of the stator winding.

It is NOT UNCOMMON to experience motor current draws in excess of the motor nameplate full load current in any valve actuator application. Determination of running loads for a valve is an inexact science and the actual values can vary depending on finishes, fits, etc.

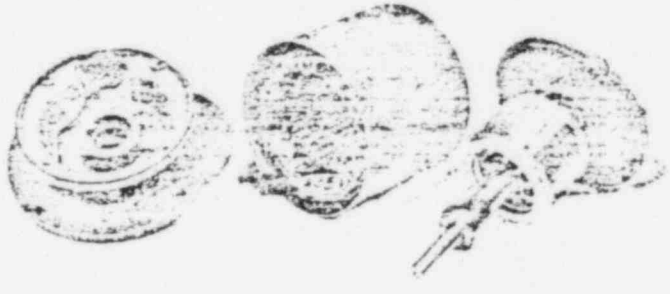
Apparent overcurrent may be further magnified by such conditions as an overly tight valve stuffing box, dirty or unlubricated valve stem. Although this condition is adequately covered by the motor thermal rating, it could cause nuisance tripping on thermal overload devices which are sized on motor full load current only.

Before increasing the size of the motor overload devices, check all of the operating conditions to ensure a problem does not exist in the valve itself.

Further information may be obtained from any of the local Limitorque sales offices or by writing to Limitorque Corporation, Lynchburg, Va. 24506.



Typical nuclear containment motor—NEMA 184 frame.



Typical weatherproof motor—NEMA 56 frame.

LIMITORQUE CORPORATION
OFFICES IN PRINCIPAL CITIES

5114 Woodall Road, Lynchburg, Virginia 24506

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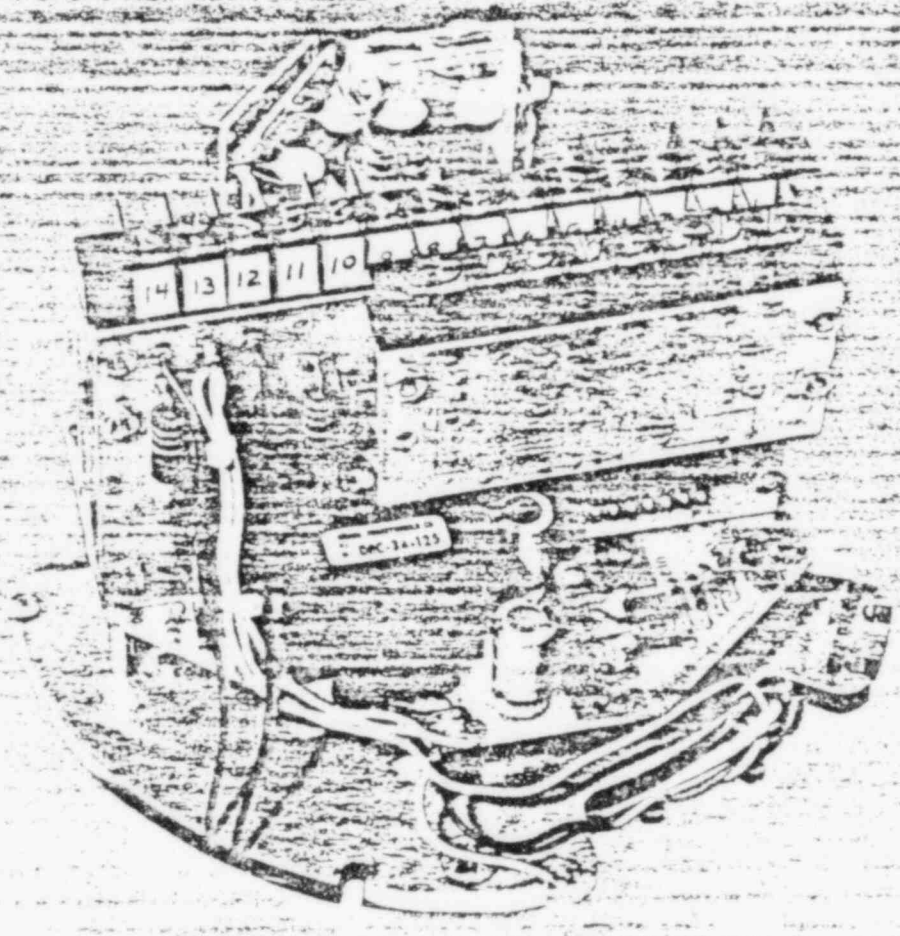
LIMITORQUE MODUTRONIC 10

INSTRUCTION AND MAINTENANCE MANUAL

SMC ACTUATORS



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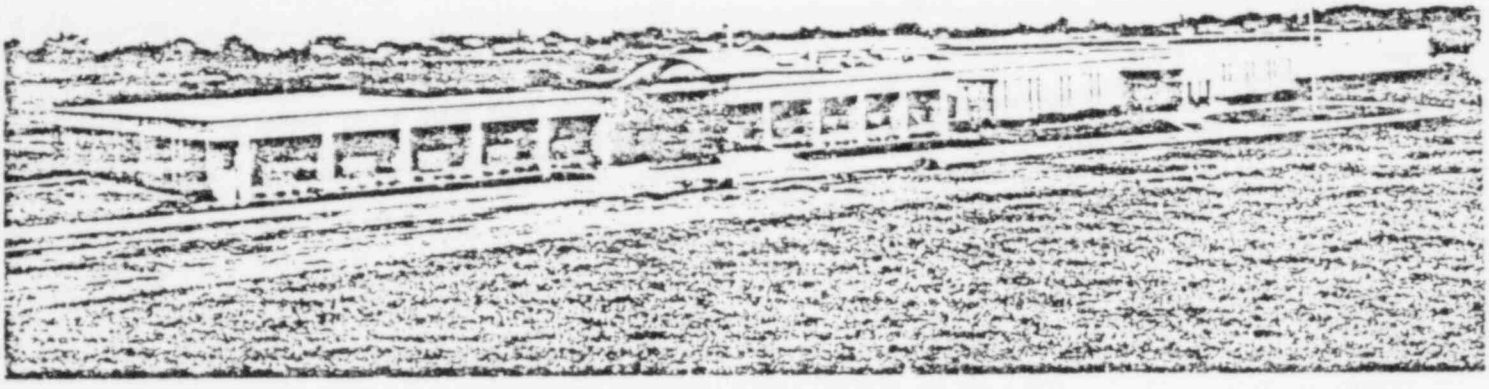


Limitorque Corporation/Lynchburg, Virginia

Your Limitorque Valve Control...

Limitorque is the most advanced valve control on the market ... the result of many years of constant improvement and development. This booklet has been prepared to help you obtain the most benefit and use from your Limitorque valve controls. It contains instructions on the installation and maintenance of these units, plus helpful suggestions enabling you to become thoroughly familiar with the location and proper use of operating controls. Before you do anything be sure to read this booklet through at least once, then always keep it handy for ready reference.

Limitorque controls the opening and closing travel of the valve and limits the torque and thrust loads with its torque limit switch. As a result, all valve operating parts are protected from overload, improper seating and foreign obstructions.

Limitorque controllers may be mounted on any size valve in almost any position or location. Readily adaptable to existing equipment, Limitorque can be actuated by electricity, hydraulic pressure, air or natural gas.

How to Order Parts:

To obtain further information or order parts for your Limitorque Valve Control, contact your local representative or write to:

Limitorque Corporation
5114 Woodall Road
Lynchburg, Virginia 24506
Attention: Manager, Parts and Service
(804) 528-4400
Telex 82-9448

All inquiries or orders MUST be accompanied by the following information which can be obtained from the unit name plate.

Unit Size and Type
Serial Number
Limitorque Corporation Order Number

Where To Find Information

INITIAL CHECK-OUT

Read instructions completely before attempting to calibrate or troubleshoot this unit.

For the Modutronic 10 to operate properly, it must be wired correctly to actuator limit and torque switches, feedback potentiometer, motor, command signal selector switch, and pushbuttons if supplied.

The basic wiring to these devices is shown in the typical wiring diagram. However, you must refer to the wiring diagram specifically assigned to your actuator to assure that all wiring is correct.

CONTROL SIGNAL WIRING

Description of internal wiring is provided here as an aid to checkout and maintenance, these connections will have already been made at the factory.

LIMIT SWITCHES:

Wiring is based on whether an increasing or decreasing signal is to open the valve. (See assigned wiring diagram).

A. If command signal increases to open the valve, the open direction limit switch and torque switch are connected in series to Wire No. 41 and the closed direction limit and torque switch are connected in series to Wire No. 51 coming from the Modutronic assembly. The common line is connected to Wire No. 18C when supplied with an auto-manual selector switch and Wire No. 19 when supplied with an auto-off-manual switch.

B. If command signal decreases to open the valve, the open limit switch is connected to Wire No. 51 and the close limit switch is connected to Wire No. 41. The common wire is connected as above.

FEEDBACK POTENTIOMETER WIRING:

Slider is connected to Terminal 3 on the Modutronic assembly. The end terminals of the potentiometer are connected to Terminals 2 and 4. Proper connection of end terminal wires is discussed later in these instructions.

COMMAND SIGNAL WIRING:

All signal wires are to be free of electrical noise and interference. It is highly recommended that all signal wires be run in shielded cable.

A. **Milliamp Command Signals:** Connect + to Terminal 11 and − to Terminal 9 on the Modutronic terminal strip.

Check removable calibrating resistor installed between terminals 11 and 9 on the comparator board. It should be of the following value:

Command Signal Is:	The Calibrating Resistor Value is:
1 to 5 milliamps	1000 ohms
2 to 10 milliamps	500 ohms
4 to 20 milliamps	250 ohms
5 to 25 milliamps	200 ohms
10 to 50 milliamps	100 ohms

For other values of milliamp signal, use the equation: 5 volts ÷ maximum milliamp value = ohms for calibrating resistor.

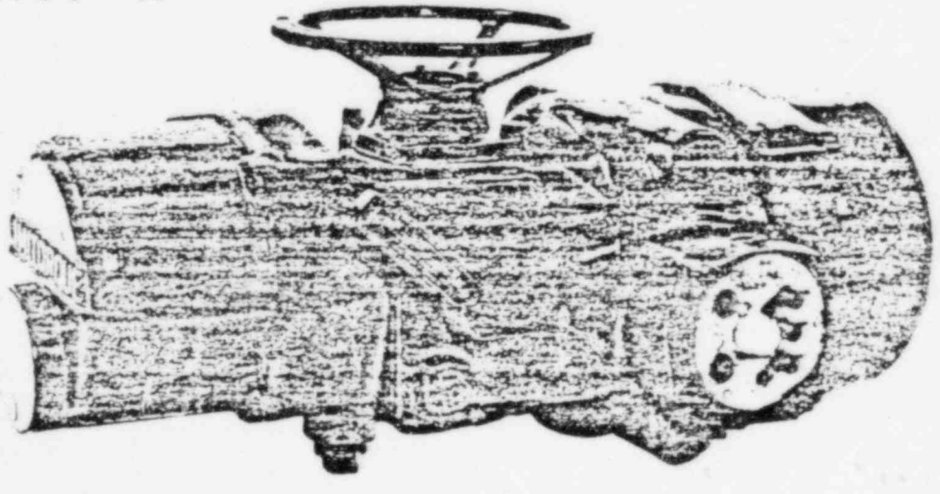
B. **Voltage Command Signals:** For 1 to 5 volt signals, connect + to Terminal 11 and − to Terminal 9 on the Modutronic terminal strip. For all other voltages, consult Limitorque factory representative.

C. **Potentiometric Command Signals:** Command pot should be 0 to 1000 ohms. Connected to the Modutronic terminal strip as follows:

1. Connect Slider to Terminal 11.
2. Connect counterclockwise terminal to Terminal 12.
3. Connect clockwise terminal to Terminal 10.

Note: With this connection, the valve will open upon turning the command pot shaft clockwise. If the opposite action is desired, reverse the connections at Terminals 10 and 12.

Note: Only one type and value of command signal may be connected to the Modutronic at any one time. If more than one command signal is required, see the wiring diagram assigned to your order for proper connections.



CONTROL ELEMENTS

Standard/Optional

A "Auto-manual" selector switch (standard) Selector switch is wired across Terminals 7 and 8. When selector switch is in "manual" position there is a connection between 7 and 8. This allows "handwheel" or pushbutton operation.

B "Auto-off-manual" selector switch (optional) Connected as above. In addition there is a contact wired in the limit switch common line from the Modutronic which, when opened, prevents motor operation.

C "Open-stop-close" selector switch (optional) This switch allows manual operation of the actuator without the requirement that a button be held to continue operation.

D "Open-close" pushbuttons (optional) These pushbuttons allow operation of the actuator manually. The buttons must be held in to continue operation.

EXTERNAL CONNECTIONS

These are connections which are normally made by the customer at the jobsite. All external wiring will be accomplished at the geared limit switch terminal strip. Single phase power is connected to Terminals L1 and L2. See assigned wiring diagram for connection of command signal. (connected to limit switch terminal strip)

SET-UP AND CALIBRATION PROCEDURE

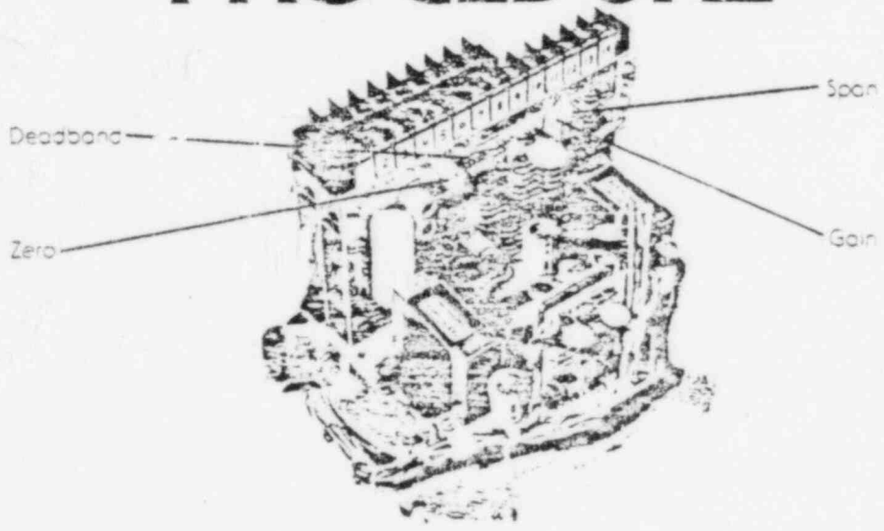


Figure 1—Modutronic 10 Control Locations

A Presetting (See Figure 1 for location of control)

1. With POWER OFF, set the selector switch to "manual" mode or "local" mode.
2. Turn GAIN adjustment fully clockwise. (These are 20-turn potentiometers which "click" faintly upon reaching an endpoint.)
3. Set DEADBAND Switches 4, 3 and 2 to "off" and 1 to "on". (Minimum deadband)
4. Turn ZERO potentiometer to midpoint. (Approximately 15 turns from endpoint)
5. Turn SPAN adjustment fully counterclockwise. (Minimum span) Now turn back two turns clockwise.
6. Set open and close limit switches using the instructions found in SMC-04/00-80 instruction manual.
7. Place the actuator in mid-travel using the handwheel.
8. Turn on power. Run the unit electrically in either the open or closed direction for only enough time to verify proper rotation. This can be accomplished by use of the pushbuttons. If pushbuttons are not supplied, jumper Modutronic Terminal 5 momentarily to Terminal 14 to close the valve or to Terminal 10 to open the valve.
9. If the actuator runs in the opposite direction than that expected, it will be necessary to switch the motor leads where they are connected to the geared limit switch terminal strip.
10. Run the unit to the 50 percent position. Turn off power. Read the resistance between Modutronic Terminal 3 (feedback pot slider) and Terminal 2. You should read 500 ± 10 ohms. If you do not get this reading, loosen the set screw on the feedback

potentiometer shaft. (See figure 2. Turn the shaft until you get the proper reading from Terminal 3 to Terminal 2. RETIGHTEN THE SET SCREW.

11. Move the valve towards the open position. Note whether the D.C. voltage from Terminal 3 to Terminal 9 on the Modutronic increases or decreases. If the command signal (in automatic mode) is to increase to open the valve, the feedback voltage should move towards + 5 volts. If the command signal is to decrease to open the valve, the feedback voltage should move towards − 5 volts. If the feedback voltage moves in the wrong direction upon opening the valve, TURN OFF POWER, reverse the wires on Terminal 2 and Terminal 4 and verify proper rotation.

D. Calibration Procedure

1. Set the process controller or command potentiometer to minimum input signal.
2. Place the unit in "automatic" mode. The unit may run somewhat toward the position called for by the minimum command signal.
3. Turn the ZERO control clockwise until the limit switch trips.
4. Set the process controller or command pot to maximum signal. The actuator may run toward the position called for by that signal and stop somewhere short of that limit. Now slowly turn the span control clockwise until that limit just trips.
5. Because the SPAN and ZERO controls affect one another, it may be necessary to alternate between the maximum and minimum command signal once or twice more and "fine tune" the span and zero controls until they are at the correct point. This procedure should only take several minutes on units with a short operating time. Care should be taken, especially on units with longer operating times, that the duty cycle of the motor is not exceeded.
6. Deadband switches normally are set so that the actuator will not track variations of less than + or − 5 percent in the process control signal. Minimum deadband is usually a satisfactory setting, but if the actuator oscillates (seems to "hunt" or continually moves back and forth) while following the process control signal, it may be necessary to use a higher deadband setting. If another wider deadband percentage is needed, refer to the table below for deadband switch settings.

For this deadband percentage	Set these Switches On
± .5	1
±1.0	2
±1.5	1,2

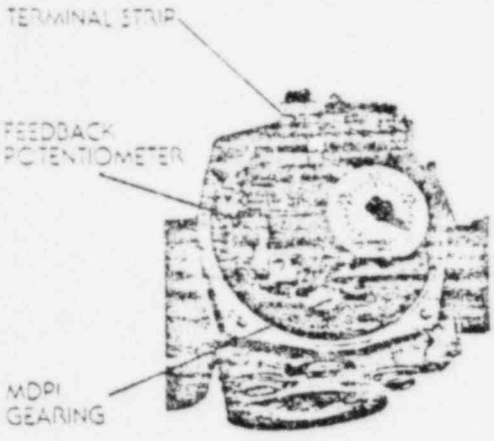


Figure 2 — MDPI Gearing and Feedback Potentiometer

Note: If all switches are off, deadband is zero. This is almost always an unstable setting and generally should not be used.

C. Function of the Gain Adjustment

The gain adjustment is used to assure stable operation of the Modutronic-Limitorque actuator system. With the gain potentiometer fully clockwise, gain is minimum and the actuator will run continuously to the set point before power is removed from the motor. With higher speed units, some overshoot may occur with this gain setting. To correct this, the gain potentiometer should be turned a small amount counterclockwise and the unit tested for proper operation. Continue adjusting the gain in small increments until the unit stops on the set point without overshoot. On units with longer operating times, care should be taken not to use too high a gain setting as this will cause long periods of on-off pulsing. Generally, the lowest gain setting that gives no overshoot is recommended.

D. Other controls located on the Modutronic unit. You will note that there are several other potentiometer type adjustments on the Modutronic assembly. These are factory set and should not be adjusted by the user.

SUMMARY OF CALIBRATION PROCEDURE

See SMCI-04/03-80. Set geared limit switch.

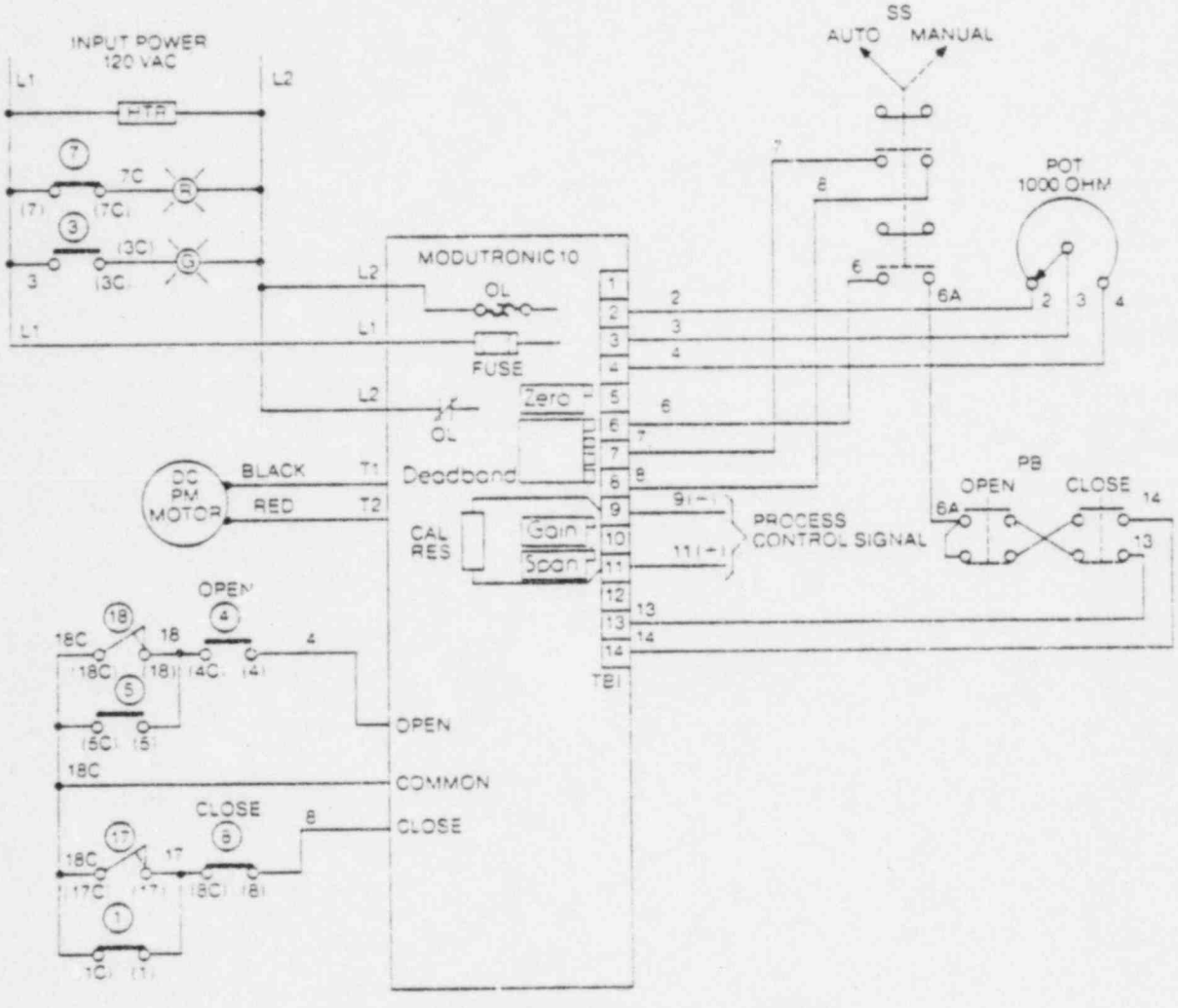
Preset:

1. Select manual mode
2. Gain-clockwise
3. Deadband-Switch 2, 3, and 4 off, 1 on
4. Zero-15 turns from endpoint
5. Span-counterclockwise, back clockwise 2

Calibrate:

1. Set minimum input (usually 4 milliamps)
2. Select auto mode
3. Zero-clockwise to limit switch trip point
4. Set maximum input (usually 20 milliamps)
5. Span-clockwise to limit switch trip point
6. Fine tune zero and span
7. Select minimum deadband for no oscillation
8. If required-turn gain counterclockwise for no overshoot

TYPICAL WIRING DIAGRAM



MODUTRONIC 10—SMC

TROUBLE-SHOOTING

If the set up and calibration procedure was followed but proper operation was not obtained, check the following first:

1. Is power properly connected to the unit?
2. Does feedback voltage move in proper direction upon opening valve? (See Set up and Calibration Procedure—Presetting, Section A-11).
3. Is the coupling tight on the feedback potentiometer shaft?
4. Are all wiring connections tight?

Symptom—Actuator will not run-even in manual mode. (unit in mid-travel-limit switches set.)

1. Check Modutronic line fuse.
2. Check for tripped overload relay. If overload is tripped, allow unit to cool and then reset.
3. Disconnect the motor leads from the gear limit switch terminal strip. With unit in manual mode (Modutronic Terminal 7 shorted to Terminal 8), connect a jumper from Terminal 6 to Terminal 10. This energizes the unit to open the valve. Read D.C. voltage across the motor connection (Terminal Points T1 and T2) on the gear limit switch terminal strip. If you do not read at least 80 V.D.C., replace the Modutronic. If you do read 80 volts or more, turn off power and check motor brushes for excessive wear and for continuity. If brushes appear to be worn or do not have continuity from brush to connecting ring, replace them.

Symptom—Unit will only run in one direction.

1. Check for proper setting of limit switches.
2. With unit energized in appropriate direction, check for a voltage reading across limit switch Terminal 41 to 18 and 51 to 17 and across torque switch Terminals 18C to 18 and 17C to 17. If 120 volts (nominal) is present across any one of these terminals, that contact is bad.

Symptom—The full range of the analog input signal does not result in full travel, even with maximum span adjustment.

1. Check span adjustment, zero adjustment.
2. Check for proper calibrating resistor value. (See Page 3 Command Signal Wiring)
3. Check that the analog input signal is of proper value.
4. Check geared limit switch adjustment (See SMBI-180.)

Symptom—As the actuator follows an input signal, control is erratic throughout the range, that is, the operator will not track the input signal smoothly.

1. As the actuator is moved (in manual mode) from open to close, monitor the feedback voltage from Terminal 3 to 9. It should go smoothly from approximately −4.8 volts to +4.8 volts. If the voltage takes a sudden jump from one direction to the other, the feedback pot is adjusted such that it is being driven beyond its end point. It will then be necessary to loosen the set screw on the feedback potentiometer shaft and readjust the position of feedback potentiometer wiper.

If the voltage is erratic as the actuator moves from open to close, the feedback pot may have become contaminated with dirt. Replace the pot.

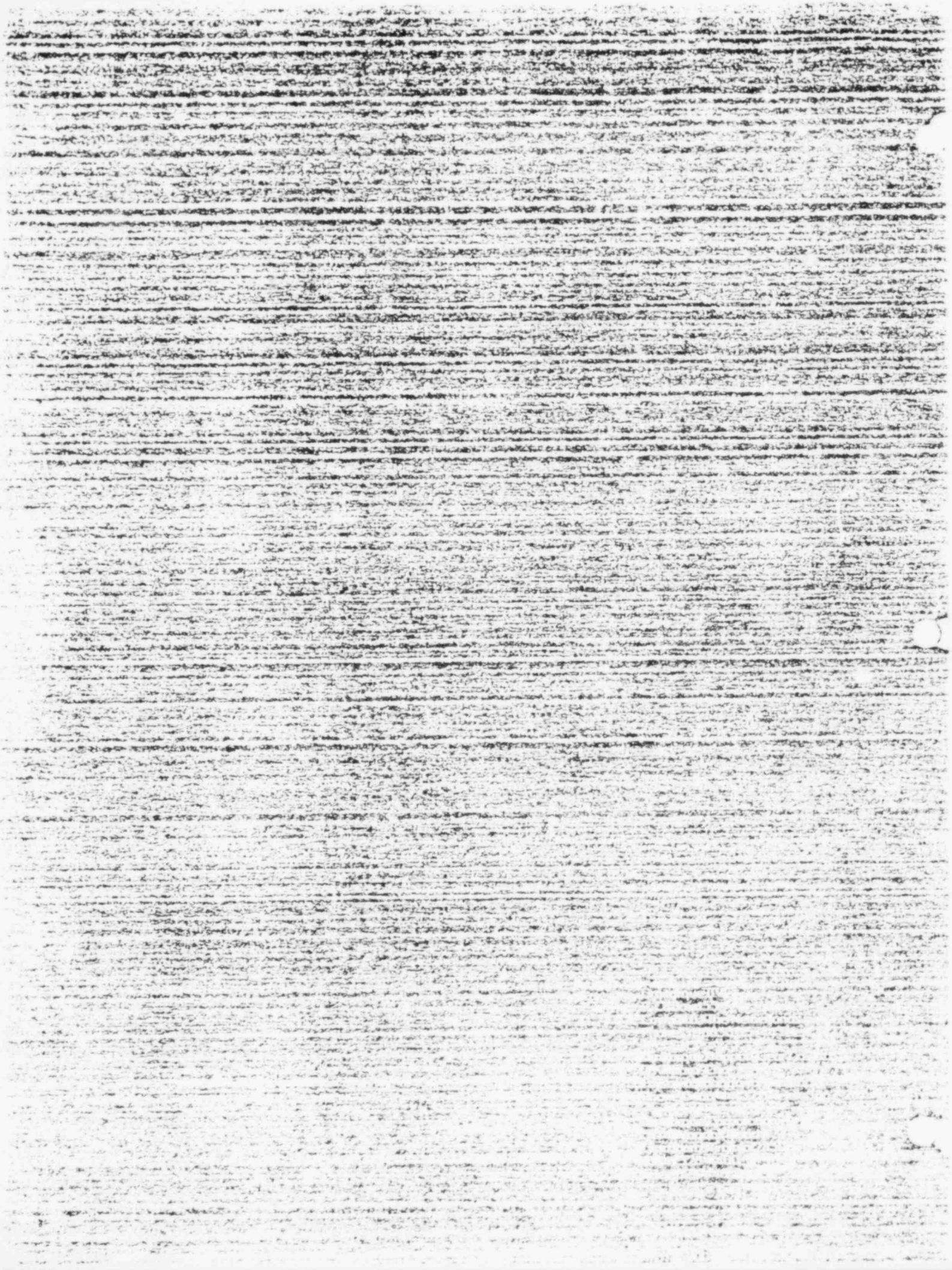
Symptom—Large input signal variations result in little or no movement of the actuator.

1. Check that unit is in "auto" mode.
2. Check deadband setting. It may be too high.
3. Check span setting.

Symptom—Unit will not operate in automatic mode (operates properly in manual mode).

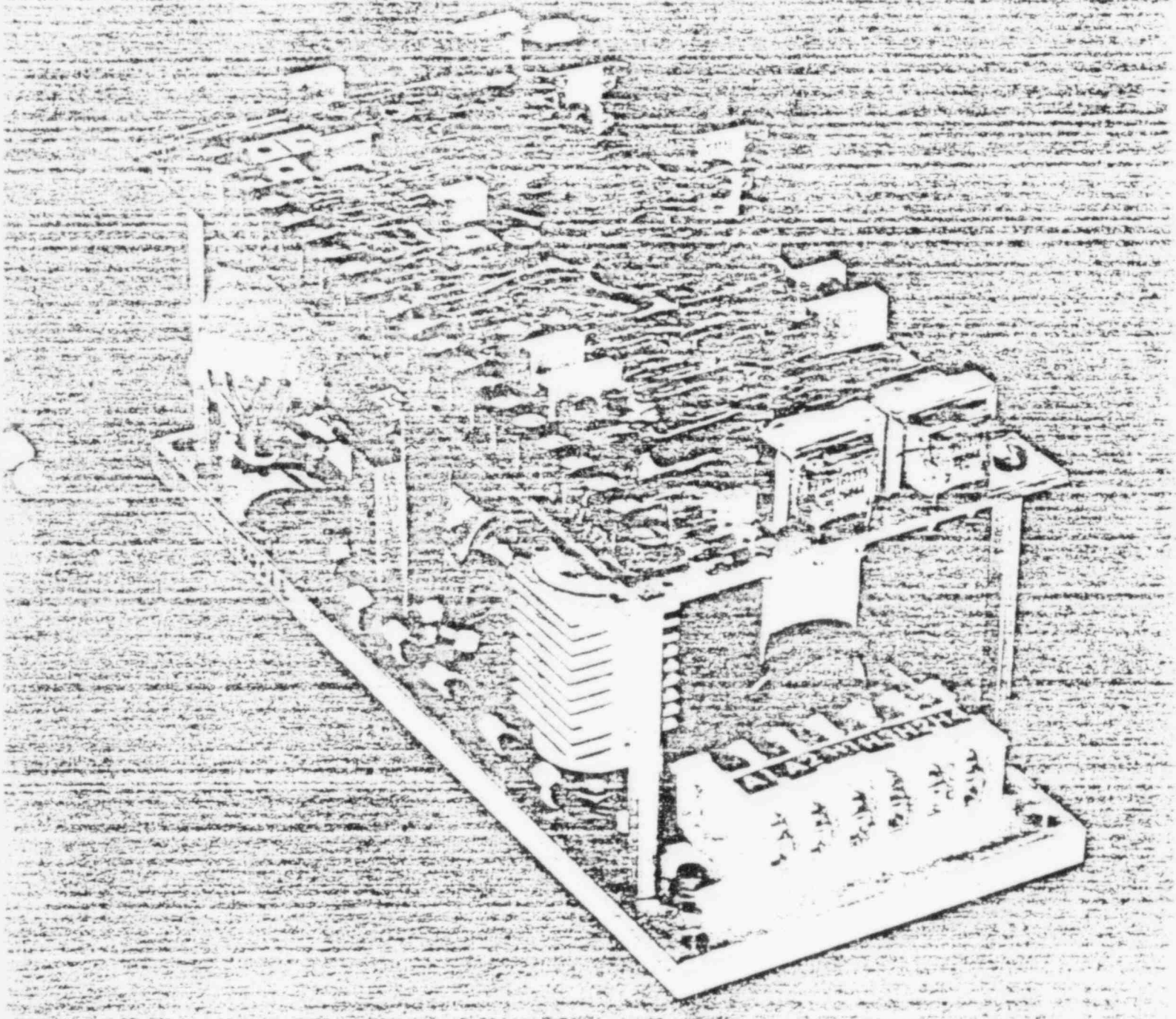
1. Check that when the unit is in automatic mode there is no short circuit between TB4-7 and 8 on the comparator board.
2. Check that the input signal is connected with the positive going to TB4-11 on the comparator board and the negative going to TB4-9 on the comparator board.
3. Check that the proper calibrating resistor for your input signal is installed between TB4-11 and 9 on the comparator board.

If the set up and calibration procedure and the troubleshooting procedure are followed and you are still unable to get the Modutronic to operate properly, please call the nearest Limitorque office. Give them the actuator "order number" and "serial number" (found on actuator nameplate) and a description of the malfunction.



LIMITORQUE MODUTRONIC 10A & 10B

D.C. MODULATING CONTROL SYSTEM



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MODUTRONIC 10A

LIMITORQUE D.C. MODULATING CONTROL SYSTEM

The Limitorque D.C. Modulating Control System, designated the Modutronic 10A, provides the user with the capability of controlling linear or rotary motion in response to a position demand signal (process control signal) utilizing a D.C. motor. The circuitry in the modulating system takes advantage of the dependability and compactness of solid state components.

The system consists of a comparator circuit board mounted on a base plate on which the D.C. power-handling components are also mounted (See front cover).

The comparator board receives a position demand signal (output from a set point process controller) and compares that signal with an internal position feedback signal from the actuator. Any difference (beyond a set deadband), between the position demand and position feedback signals will result in a triggering of the appropriate SCR in the power-handling circuit.

ADVANTAGES OF THE MODUTRONIC 10A CONTROL SYSTEM

Flexibility. The Modutronic 10A can accept input from a remote command potentiometer or local or remote open-close pushbutton. A switch is provided to select either manual operation (by pushbuttons or handwheel) or automatic operation (by process controller signal or by remote command potentiometer).

The Modutronic 10A is designed to accept the usual output signal from a process controller of 4 milliamps to 20 milliamps D.C. Other analog signals of either 1 milliamp to 5 milliamps, 2 milliamps to 10 milliamps, 5 milliamps to 25 milliamps, 10 milliamps to 50 milliamps, or 1 to 5 volts D.C. may be used to drive the Modutronic 10A.

Compactness. The Modutronic 10A is packaged to fit within the limit switch compartment as an integral unit on all Limitorque actuator sizes. Field wiring is thus simplified and usually limited to two leads from the process controller and two leads to supply power to the unit.

Reliability. Solid state components used throughout the system give the Modutronic 10A a very high reliability.

STANDARD CONTROL FEATURES:

Span — The span adjustment calibrates the position feedback potentiometer (on the Limitorque actuator) to cause the full rotation of the output shaft to correspond to the full zero to 100 percent range of the signal from the set point controller.

Zero — The zero adjustment calibrates the position feedback potentiometer (on the Limitorque actuator) to cause the position of the output shaft to correspond with the minimum input signal.

Gain — The gain adjustment controls the rate at which the operator responds to a given error signal. For higher gain settings the actuator will respond to a change in the set point signal more quickly.

Deadband — This control determines the magnitude of error signal that occurs before the motor begins to rotate. The intent is to control hunting or excess running of the motor. Too wide a deadband will reduce the control accuracy. Too narrow a deadband can result in excessive armature current. Changing the gain adjustment may require an opposite change of the deadband adjustment.

Boost — This is an automatic feature of the Modutronic control. When a small error signal is produced by the process controller the low voltage applied to the motor armature may be insufficient to cause rotation. The boost feature applies extra voltage to start motor rotation, then restores the lower voltage for slow rotation until the desired position is reached.

Position Feedback Signal. The Modutronic control unit is furnished with a feedback potentiometer mounted on the Limitorque actuator for use in balancing the control circuits. An additional potentiometer can be added for position indication when required by the customer.

Mounting — Cooling. To prolong component life, the heat generated within the armature rectifiers must be instantly carried away. In the Modutronic 10A control unit, cooling is obtained by conducting the heat through the base plate to the entire Limitorque actuator housing.

CONTROL OPTIONS (MODUTRONIC 10B)

The addition of another circuit board, mounted on standoff above the Modutronic 10A control board, makes available several optional control modes. These control options are:

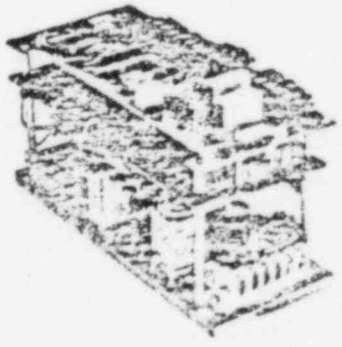
Speed Control Option — A speed control option is available to adjust the maximum speed of the motor. With this option, the maximum rate of actuator movement is limited. The motor speed limit is adjustable from 2100 RPM to 500 RPM. The Modutronic can be applied as a speed control device only with its inputs received from pushbuttons. This application would be considered when the optimum rate of valve travel is unknown. In modulating systems, where the standard milliamp signal controls the Modutronic, the rate of travel for large signal changes is limited by the speed control option.

Current Limit Plugging — This option is available to cause the motor to be plugged to zero speed when the pushbutton input is removed. Current limit plugging allows small increments of valve travel from a pushbutton or contact closure input.

ADDITIONAL AUXILIARY CONTROL OPTION

(Available on Mod 10A or Mod 10B)

Loss of Signal Options — If the input signal from the process controller is lost due to a broken wire or some such failure, the



operator will move to the position called for by the minimum input signal. The normal arrangement of Modutronic wiring is to establish the minimum signal as the "full close" position, however this mode could be changed to "full open" on request.

A "loss of signal" control option is available to provide alternate operations. This option is provided by an additional circuit board that is connected to provide one of two types of action upon "loss of signal":

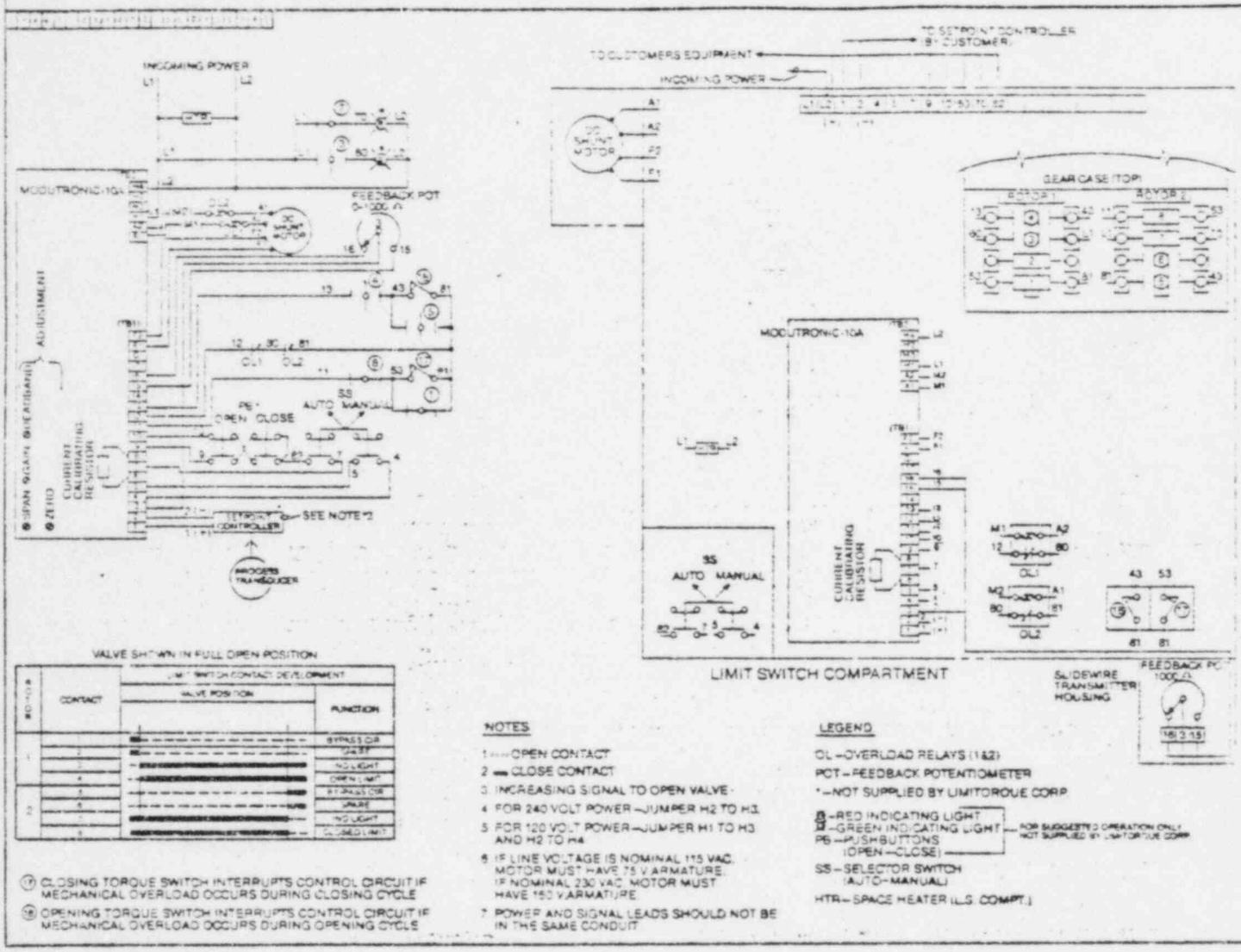
A. Lock-In-Last Position. The operator will stop and remain in its last position whenever the input signal falls below a minimum value.

B. Lock-In-Last and Position. The operator will move to a position determined by a separate command potentiometer whenever the command signal falls below a minimum value.

Manual Control. Although a 2-position auto-manual selector switch is standard with the Modutronic 10, a 3-position auto-stop-manual selector switch is available as an option.

An open-stop-close selector switch is optional and is recommended over open-close pushbuttons for simplicity and cost savings.

TYPICAL MODUTRONIC 10A WIRING DIAGRAM



VALVE SHOWN IN FULL OPEN POSITION

MOTOR	CONTACT	LIMIT SWITCH CONTACT DEVELOPMENT — VALVE POSITION	FUNCTION
1	1		BYPASS OR CLOSE
	2		NO LIGHT
	4		OPEN LIMIT
2	5		BYPASS OR
	6		OPEN
	8		NO LIGHT
	9		CLOSED LIMIT

⑦ CLOSING TORQUE SWITCH INTERRUPTS CONTROL CIRCUIT IF MECHANICAL OVERLOAD OCCURS DURING CLOSING CYCLE

⑧ OPENING TORQUE SWITCH INTERRUPTS CONTROL CIRCUIT IF MECHANICAL OVERLOAD OCCURS DURING OPENING CYCLE

NOTES

1 — OPEN CONTACT
2 ▬ CLOSE CONTACT
3. INCREASING SIGNAL TO OPEN VALVE
4. FOR 240 VOLT POWER — JUMPER H2 TO H3
5. FOR 120 VOLT POWER — JUMPER H1 TO H3 AND H2 TO H4
6. IF LINE VOLTAGE IS NOMINAL 115 VAC, MOTOR MUST HAVE 75 V ARMATURE. IF NOMINAL 230 VAC MOTOR MUST HAVE 150 V ARMATURE
7. POWER AND SIGNAL LEADS SHOULD NOT BE IN THE SAME CONDUIT

LEGEND

OL — OVERLOAD RELAYS (1&2)
POT — FEEDBACK POTENTIOMETER
* — NOT SUPPLIED BY LIMITORQUE CORP.
R — RED INDICATING LIGHT
G — GREEN INDICATING LIGHT — FOR SUGGESTED OPERATION ONLY NOT SUPPLIED BY LIMITORQUE CORP.
PB — PUSHBUTTONS (OPEN — CLOSE)
SS — SELECTOR SWITCH (AUTO — MANUAL)
HTR — SPACE HEATER (LS. COMPT.)

APPLICATION NOTES

Limitorque's Modutronic 10A system is designed to complement the A.C. Modutronic 30 system. Input configurations are essentially the same as are the controls. Both systems allow input from most process controllers, from command potentiometers, selector switches, or pushbuttons. Controls provided are zero, span, gain and deadband.

1. The capability of controlling D.C. motors (shunt wound) makes the Modutronic 10A system ideal for applications requiring motor torques less than 15 ft. lbs. Applications requiring higher motor torques are generally more suitable economically for Limitorque's A.C. Modutronic 30 system.

2. For explosion proof and submersible applications, the savings involved in using a 3 phase A.C. motor instead of a D.C. motor make the Modutronic 30 system economically preferrable to the Modutronic 10A. Please consult your Limitorque factory representative.

3. Motor duty should be considered when selecting a modulating system. If frequent repositioning is anticipated, the motor should be capable of repeated starts without overheating. Actuators with very long strokes or operating times or those that tend to be repositioned more frequently require motors that are rated for this more severe modulating service. For stroke times greater than 3 minutes for the Modutronic 10A or 5 minutes for the Modutronic 30, the factory should be consulted.

4. For applications that require infrequent repositioning (throttling), a Modutronic 40 system should be considered. With this system, the comparator section of the Modutronic 30 is used with a standard electro-mechanical reverser which will yield a cost savings.

5. Where environmental conditions are severe, i.e. extreme temperatures or high vibrations, it may be desirable to locate the Modutronic 10A in a remote location from the actuator. In this case, it is necessary to run the four motor power wires, three wires for feedback potentiometer in a shielded cable and three wires to and from the torque and limit switches from the remote location to the Limitorque actuator. Five more wires are required for a selector switch and pushbuttons on the actuator.

6. In situations where it is critical that in an abnormal control situation, such as loss of the process control signal (position demand signal), that the flow rate or other parameter controlled by the valve remains constant, it would be desirable to have the lock-in-last position option. This option will cause the actuator to remain in the position called for by the last valid position demand signal before the anomaly occured. If it is important that the valve move to a preset position upon loss of position demand signal, specify the lock-in-command potentiometer option.

SELECTION CHART

MOTOR TORQUE (FT. LBS.)

Application	2-10	15-25	40-80	100-200
Weatherproof	Mod 10A	Mod 30-3	Mod 30-10	Mod 30-25
Explosion Proof	Mod 30-1	Mod 30-3	Mod 30-10	Mod 30-25
Submersible	Mod 30-1	Mod 30-3	Mod 30-10	Mod 30-25
Low Cycle Rate	Mod 40-1	Mod 40-3	Mod 40-10	Mod 40-25

Note: For Information Regarding Mod 30/Mod 40 Refer To Specific Bulletin

MODUTRONIC 10A

ENGINEERING AND PERFORMANCE SPECIFICATION

ELECTRICAL CHARACTERISTICS:

Line Voltage

Line voltage can be from 90 to 140 or from 180 to 280 volts RMS depending on motor size and transformer connections. Maximum voltage surge is 600 volts peak. Maximum rate of rise of surge is 100 volts per microsecond.

Line Current

Line current for a non-rotating motor is 3 amperes RMS maximum. Running current is 40 amperes RMS maximum continuous. Maximum locked rotor current is 80 amperes RMS for a maximum of 6 seconds.

SIGNAL INPUTS:

Set Point Input:

Current mode: 1. From any controller providing milliamp current in a range of 1 to 50 milliamperes. 2. Calibrating resistors for current signals.

Input Current Range	Resistor Value
1 to 5 milliamps	1000 ohms
2 to 10 milliamps	500 ohms
4 to 20 milliamps	250 ohms
5 to 25 milliamps	200 ohms
10 to 50 milliamps	100 ohms

Voltage mode: 1 to 5 volts standard. For other voltages, consult factory.

Command Potentiometer: 0 to 1000 ohm pot.

Feedback Input: 0 to 1000 ohm potentiometer sweeping. 750 ohms standard. For other feedback modes, consult factory.

OUTPUTS:

Motor Field

Full wave rectified from line voltage.

Current, continuous, D.C. amperes – 2 max.

Current surge, 8.3 milliseconds, amperes – 50 max.

MOTOR ARMATURE:

Half wave rectified, conduction angle control.

Continuous current, D.C. amperes (average) at 50°C base plate – 25 max.

Locked rotor, 6 seconds, D.C. amperes – 55 max.

Current surge, absolute peak, 8.3 milliseconds maximum amperes – 1200 max.

Current surge, absolute peak, 10 cycles, amperes – 800 max.

Fusing limit: a thyristor may be destroyed by long duration surges.

Maximum limit of amperes^2 x seconds must not exceed – 6000 max.

D.C. VOLTAGE OUTPUTS (Control Elements):

Output for position feedback potentiometer obtained from internal common power supply regulated to 0.1 percent. Total resistance of feedback potentiometer, ohms – 1000 max.

Output for potentiometeric control is obtained from an internal common supply regulated to 0.1 percent and is precalibrated for a 1000 ohm potentiometer.

ENVIRONMENT:

Satisfactory operation will be obtained during application of the following environmental conditions.

Temperature, centigrade
−20° to +70°C
Storage temperature, centigrade
−40° to +100°C
Storage temperature, fahrenheit
−40° to 212°F
Humidity, relative
0−95%
Altitude, mean sea level,
−200 to +10,000 feet.

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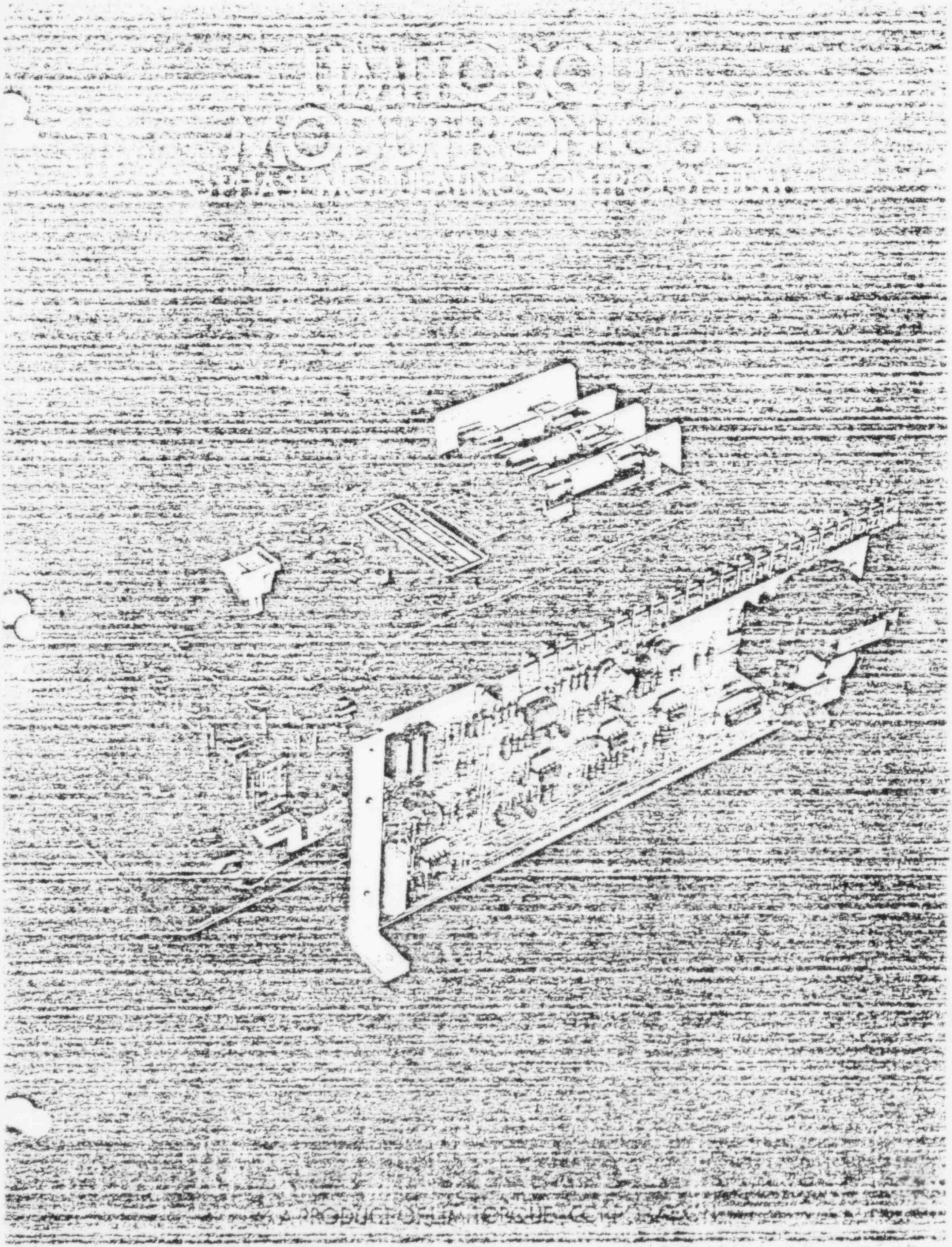


MODUTRONIC 30
AC MODULATING CONTROL SYSTEM

The Limitorque 3 Phase Modulating Control System designated the Modutronic 30 provides the user with the capability of controlling linear or rotary motion in response to a position demand signal (process control signal) utilizing a 3 phase motor.

The logic circuitry in the modulating system takes advantage of the dependability of solid state circuitry and utilizes integrated circuits for compactness. The system is therefore very reliable and is designed to eliminate periodic electrical maintenance.

The system consists of a main electronic circuit board (comparator section) and a solid state reverser (motor power control section). The main circuit board receives a position demand signal (output from a set point process controller) and compares that signal with an internal position feedback signal from the actuator. Any difference between the position demand and position feedback signals (beyond set deadband) will result in a triggering of the appropriate thyristor in the solid state reverser. This will power the motor with full AC voltage and cause the motor to run until the position demand and position feedback signals balance.

Of prime interest with a modulating system is control of overshoot. Overshoot is controlled by the Modutronic 30 by pulsing the motor power on and off as the actuator nears the set point. This causes the actuator to slow down as it approaches the set point and makes it possible for it to respond accurately with little or no overshoot to a change in position demand signal.

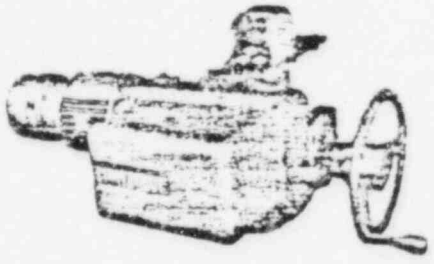
ADVANTAGES OF THE MODUTRONIC 30 CONTROL SYSTEM

Compactness. The Modutronic 30 is packaged to fit within the limit switch compartment as an integral unit on all Limitorque actuator sizes. Field wiring is thus simplified and usually limited to two leads from the process controller and three leads to supply 3 phase power.

Flexibility. The Modutronic 30 can accept input from a remote command potentiometer or local or remote open-close pushbuttons. A switch is provided to select either manual operation (by pushbuttons or handwheel) or automatic operation (by process controller signal or by remote command potentiometer).

The Modutronic 30 is also designed to accept the usual output signal from a process controller of 4 milliamps to 20 milliamps DC. Other analog signals of either 1 milliamp to 5 milliamps, 2 milliamps to 10 milliamps, 5 milliamps to 25 milliamps, 10 milliamps to 50 milliamps, or 1 or 5 volts DC, may be used to drive the Modutronic 30.

Digital signals in the form of contact closures or triac outputs may be utilized by connecting the digital output of the process controller directly to the input of the solid state reverser.



Standard Control Features. The control adjustments described briefly in this section are calibrated at the time of installation. (Refer to cover photo.)

Span.—The span adjustment calibrates the position feedback potentiometer (on the Limitorque unit) to align the full travel of the actuator with the full zero to 100 percent range of the position demand signal.

Zero.—The zero adjustment calibrates the position feedback potentiometer (on the Limitorque unit) to align the appropriate end of travel position of the actuator to correspond with the minimum input signal.

Gain.—The gain adjustment is used to assure stable operation of the Modutronic 30 and hence the Limitorque actuator. With full gain, the actuator will run continuously up to the deadband set point. As the gain setting is lowered the Modutronic will begin to "pulse" the motor as the set point is approached. As the actuator approaches the set point, the rate at which the motor is pulsed on is decreased. When the actuator reaches the set point, the motor is turned completely off. Decreasing the gain setting even more will cause the Modutronic to go into the pulsing mode sooner (farther from the set point), and thus cause the actuator to approach the set point more slowly. This action is instrumental in preventing overshoot on higher speed units.

Deadband.—This control determines the magnitude of error signal that must be developed before the motor begins to rotate. The intent of the control is to prevent excessive running of the motor because of minor variations in the process control signal. Deadband range is adjustable between ±0.5 percent and ±10 percent. Deadband ranges other than this standard are available on special orders.

Position Feedback Signal. The Modutronic control unit is furnished with a feedback potentiometer mounted on the Limitorque operator for use in balancing the control circuits. An additional potentiometer can be added for position indication when required by the customer.

Solid State Reverser. The reverser has four thyristors which are used to control current flow in two of the three phases. Special fast-acting line fuses are utilized on all three power connections to provide built in protection for the thyristors.

As added protection for voltage surges from such things as lightning or line-to-line faults, special resistors are incorporated in the AC power line.

As an aid to calibration and troubleshooting, the solid state reverser is equipped with two Neon type indicating lights to provide a visual indication of which circuit (thus, direction of motor rotation) of the solid state starter has been triggered.

CONTROL OPTIONS

Control Options. If the input signal from the process controller is lost due to a broken wire or some such failure, the operator will move to the position called for by the minimum input signal. The normal arrangement of Modutronic 3 wiring is to establish the minimum signal at the "full close" position however, this mode could be changed to "full open" on request.

A "loss of signal" control option is available to provide alternate operations. This option is provided by an additional circuit board that is connected to provide one of two types of action upon "loss of signal".

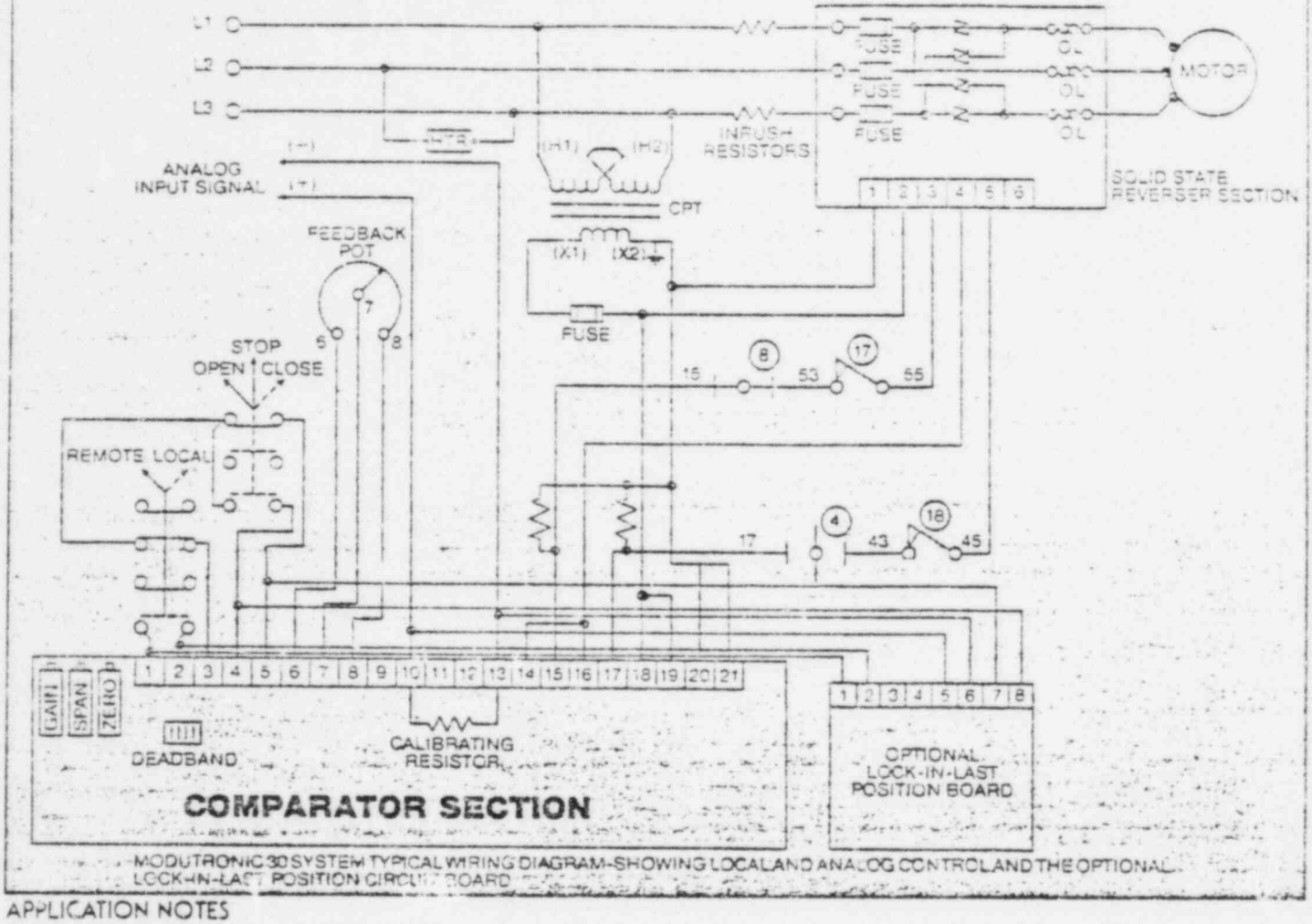
A. Lock-In-Last Position. The operator will stop and remain in its last position wherever the incoming signal falls below a minimum value.

B. Lock-In-Command Position. The operator will move to a position determined by a separate command potentiometer whenever the command signal falls below a minimum value.

Although a 2-position auto-manual selector switch is standard with the Modutronic 30, a 3-position auto-stop-manual selector switch is available as an option.

An open-stop-close selector switch is optional and is recommended over open-close pushbuttons for simplicity and cost savings.

TYPICAL MODUTRONIC 30 WIRING DIAGRAM



MODUTRONIC 30 SYSTEM TYPICAL WIRING DIAGRAM-SHOWING LOCAL AND ANALOG CONTROL AND THE OPTIONAL LOCK-IN-LAST POSITION CIRCUIT BOARD

APPLICATION NOTES

Limitorque's Modutronic 30 system is designed to complement the existing D.C. Modutronic 10 system. Input configurations are essentially the same as are the controls. Both systems allow input from most process controllers, from command potentiometers, selector switches or pushbuttons. Controls provided are zero, span, gain, and deadband.

1. The capability of controlling 3 phase motors makes the Modutronic 30 system ideal for applications which require motor torques greater than 10 ft. lbs. or where special application requirements are best handled by a 3 phase motor. Applications requiring lower motor torques are usually more suitable economically for Limitorque's D.C. Modutronic 10 system.

Selection of the Modutronic system for weatherproof applications is thus related mostly to the size motor to be controlled and to a lesser extent the type of application. Refer to the selection chart to choose the Modutronic system best suited for your application.

2. For explosion proof and submersible applications, the savings involved in using a 3 phase A.C. motor instead of a D.C. motor make the Modutronic 30 system economically preferable to the Modutronic 10. Please consult your Limitorque factory representative.

3. Motor duty should be considered when selecting a modulating system. If frequent repositioning is anticipated, the motor should be capable of repeated starts without overheating. Actuators with very long strokes or operating times, or those that tend to be repositioned more frequently require motors that are rated for this more severe modulating service. For stroke times greater than three minutes for the Modutronic 10 or five minutes for the Modutronic 30, the factory should be consulted.

4. For applications that require infrequent repositioning (throttling), a Modutronic 40 system should be considered. With this system, the comparator section is used with a standard electromechanical reverser which will yield a cost savings.

5. Where environmental conditions are severe, i.e. extreme temperatures or high vibrations, it may be desirable to locate the Modutronic 30 in a remote location from the actuator. In this case, it is necessary to run the three motor power wires, three wires for feedback potentiometer connection in a shielded cable and four wires to and from the torque and limit switches. Five more wires are required for a selector switch and pushbuttons on the actuator.

6. In situations where it is critical that in an abnormal control situation, such as loss of the process control signal (position demand signal), the flow rate or other parameter controlled by the valve remains constant, it would be desirable to have the lock-in-last position option. This option will cause the actuator to remain in the position called for by the last valid position demand signal after an anomaly occurs.

If it is important that the valve move to a preset position upon loss of position demand signal, specify the lock-in-command potentiometer option.

7. All three legs of the incoming power supply are protected by inline fuses.

8. For applications involving short operating times and a Limitorque manual unit, it is suggested that the feedback potentiometer be mounted on the manual. This configuration eliminates any extra gear lash and provides for more accurate valve positioning.

SELECTION CHART

MOTOR TORQUE (FT. LBS.)

Weatherproof	Mod 10A	Mod 30-3	Mod 30-10	Mod 30-25
Submersible	Mod 30-1	Mod 30-3	Mod 30-10	Mod 30-25

Note: For Information Regarding Mod 10/Mod 40 Refer To Specific Bulletin

MODUTRONIC 30

ENGINEERING AND PERFORMANCE SPECIFICATION

FEATURES:

A. Standard unit operates 3 phase motors with locked rotor currents up to 192 amps and full load currents up to 34 amps (approximately 200 ft. lbs.). Larger units are available on special order.

B. Can be mounted inside limit switch compartment on all units SMB-000 and larger.

C. Allows control by analog signal from almost all process controllers. May be controlled by digital signal in the form of contact closures or triac output.

D. Totally solid state comparator circuit and power output.

E. Cooling. Cooling of the solid state reverser is accomplished mainly by conduction of heat to the Limitorque gear housing. The reverser should not be operated unless it is tightly mounted to the gear housing or appropriate heat sink. The main control board requires no special cooling measures other than that of insuring that maximum ambient temperature is not exceeded.

ELECTRICAL CHARACTERISTICS:

Line Voltage

3 phase power — Voltage depends on the rating of motor supplied with actuator (typically 460 volts). The solid state reverser is capable of handling up to 525 volts ±10%.

Control Voltage — 120 VAC ± 10%. The Modutronic 30 system is normally supplied with a built in control voltage transformer with its primary connected between two phases of the 3 phase line. The main control board and solid state reverser control voltage terminals are then connected to the 120 volt transformer secondary.

Line Current

Maximum line current depends upon size of the motor supplied with the actuator. The only other limiting factor for current is the rating of the solid state reverser (power output). Standard units are capable of handling locked rotor currents up to 192 amps. Higher current capacities are available on special order units.

SIGNAL INPUTS:

Set Point Input:

Current mode: 1. From any controller providing milliamp current in a range of 1 to 50 milliamperes. 2. Calibrating resistors for current signals.

Input Current Range	Resistor Value
1 to 5 ma	1000 ohms
2 to 10 ma	500 ohms
4 to 20 ma	250 ohms
5 to 25 ma	200 ohms
10 to 50 ma	100 ohms

Voltage mode: 1 to 5 volts standard. For other voltages, consult factory.

Command potentiometer: 0 to 1000 ohm pot.

Feedback Input: 0 to 1000 ohm potentiometer sweeping 750 ohms standard. For other feedback modes, consult factory.

Control By Means of Contact Closure or Triacs

A. Connected directly to solid state reverser. Requires open, close, and common line.

B. Minimum contact rating — 10 VA.

C. Maximum frequency of signal pulses — limited by the motor.

D. Minimum time between open and close signal — 8.3 ms.

Pushbutton or selector switch connected to main control board to allow manual operation of actuator.

ENVIRONMENT:

Satisfactory operation will be obtained under the following environmental conditions:

Temperature, centigrade
−20° to + 70°C
Storage temperature, centigrade
−40° to +100°C
Storage temperature, fahrenheit
−40° to +212°F

Humidity, relative: 0−95%

Altitude, mean sea level
−200 to +10,000 feet

OUTPUTS:

The output of the Modutronic 30 system is controlled 3 phase power with a voltage of 220 to 480 volts AC. Currents of up to 192 amperes locked rotor and 34 amperes full load may be controlled. Larger current capacities are available on a special order basis.

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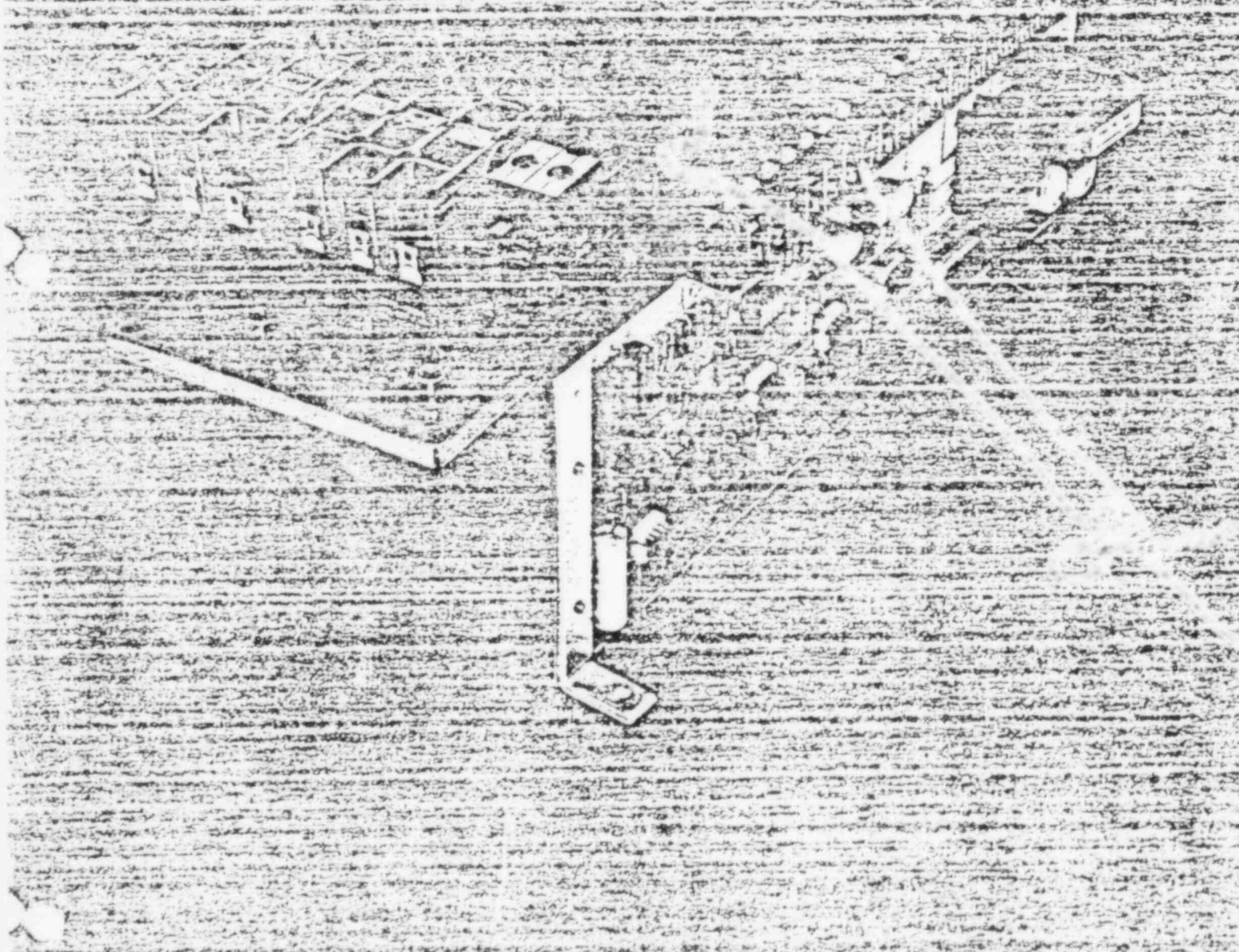
LIMITORQUE MODUTRONIC 40

3-PHASE LIMITED MODULATING CONTROL SYSTEM



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MODUTRONIC 40
A.C. LIMITED MODULATING CONTROL SYSTEM

The Limitorque 3 Phase Limited Modulation Control System designated the Modutronic 40 provides the user with the capability of controlling linear or rotary motion in response to a position demand signal (process control signal) utilizing a 3 phase motor.

The logic circuitry in the modulating system takes advantage of the dependability of the solid state circuitry and utilizes integrated circuits for compactness. The system is therefore very reliable and is designed to eliminate periodic electrical maintenance.

The system consists of a main electronic circuit board (comparator section) and electromechanical reverser (motor power control section). The main circuit board receives a position demand signal (output from a set point process controller) and compares that signal with an internal position feedback signal from the actuator. Any difference between the position feedback signals (beyond set deadband) will result in a triggering of the appropriate coil of the reverser. This will power the motor with full AC voltage and cause the motor to run until the position demand and position feedback signals balance.

Of prime interest with a modulating system is control of overshoot. Overshoot is controlled by the Modutronic 40 by pulsing the motor power on and off as the actuator nears the set point. This causes the actuator to slow down as it approaches the set point and makes it possible for it to respond accurately with little or no overshoot to a change in position demand signal. See the Application Notes contained in this bulletin for considerations concerning overshoot and the process controlled by this unit.

ADVANTAGES OF THE MODUTRONIC 40 CONTROL SYSTEM.

Compactness
The Modutronic 40 is packaged to fit within the limit switch compartment as an integral unit on all Limitorque actuator sizes. Field wiring is thus simplified and usually limited to two leads from the process controller and three leads to supply 3 phase power.

Flexibility
The Modutronic 40 can accept input from a remote command potentiometer or local or remote open-close pushbuttons. A switch is provided to select either manual operation (by pushbuttons or handwheel) or automatic operation (by process controller signal or by remote command potentiometer).

The Modutronic 40 is also designed to accept the usual output signal from a process controller of 4 milliamps to 20 milliamps DC. Other analog signals of either 1 milliamp to 5 milliamps, 2 milliamps to 10 milliamps, 5 milliamps to 25 milliamps, 10 milliamps to 50 milliamps, or 1 to 5 volts DC, may be used to drive the Modutronic 40.

Standard Control Features
The control adjustments described briefly in this section are calibrated at the time of installation. (Refer to cover photo)

Span—The span adjustment calibrates the position feedback potentiometer (on the Limitorque unit) to align the full travel of the actuator with the full zero to 100 percent range of the position demand signal.

Zero—The zero adjustment calibrates the position feedback potentiometer (on the Limitorque unit) to align the appropriate end of travel position of the actuator to correspond with the minimum input signal.

Gain—The gain adjustment is used to assure stable operation of the Modutronic 40 and, hence, the Limitorque actuator. With full gain, the actuator will run continuously up to the deadband set point. As the gain setting is lowered, the Modutronic will begin to "pulse" the motor as the set point is approached. As the actuator approaches the set point, the rate at which the motor is "pulsed on" is decreased. When the actuator reaches the set point, the motor is turned completely off. Decreasing the gain setting even more will cause the Modutronic to go into the pulsing mode sooner (farther from the set point) and thus cause the actuator to approach the set point more slowly. This action is instrumental in preventing overshoot on higher speed units.

Deadband—This control determines the magnitude of error signal that must be developed before the motor begins to rotate. The intent of control is to prevent excessive running of the motor because of minor variations in the process control signal. Deadband range is adjustable between ±0.5 percent and ±10 percent. Deadband ranges other than this standard are available on special orders.

Position Feedback Signal
The Modutronic control unit is furnished with a feedback potentiometer mounted on the Limitorque operator for use in balancing the control circuits. An additional potentiometer can be added for position indication when required by the customer.

CONTROL OPTIONS

If the input signal from the process controller is lost due to a broken wire or some such failure, the operator will move to the position called for by the minimum input signal. The normal arrangement of Modutronic wiring is to establish the minimum signal as the "full close" position however this mode could be changed to "full open" on request.

A "loss of signal" control option is available to provide alternate operations. This option is provided by an additional circuit board that is connected to provide one of two types of action upon "loss of signal".

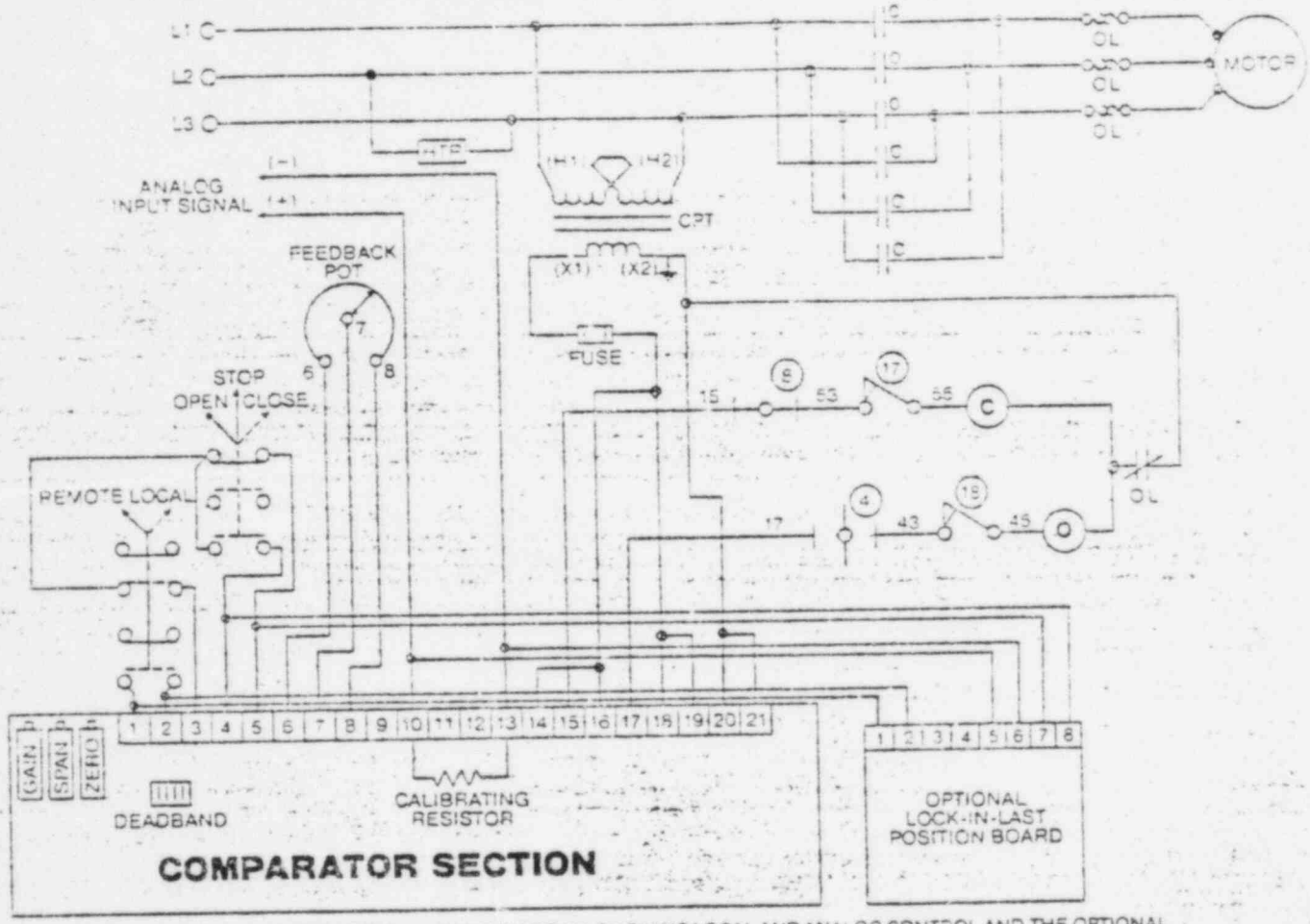
A. Lock-In-Last Position. The operator will stop and remain in its last position whenever the incoming signal falls below a minimum value.

B. Lock-In-Command Position. The operator will move to a position determined by a separate command potentiometer whenever the command signal falls below a minimum value.

Although, a 2-position auto-manual selector switch is standard with the Modutronic 40, a 3-position auto-stop-manual selector switch is available as an option.

An open-stop-close selector switch is optional and is recommended over open-close pushbuttons for simplicity and cost savings.

TYPICAL MODUTRONIC 40 WIRING DIAGRAM



MODUTRONIC 40 SYSTEM TYPICAL WIRING DIAGRAM-SHOWING LOCAL AND ANALOG CONTROL AND THE OPTIONAL LOCK-IN-LAST POSITION CIRCUIT BOARD.

APPLICATION NOTES:

Limitorque's Modutronic 40 system is designed to complement the existing Modutronic 30 and Modutronic 10A systems. All systems allow input from most process controllers, from command potentiometers, selector switches or pushbuttons. Controls provided are zero, span, gain and deadband.

1. The Modutronic 40 system is specifically suited for applications where it is necessary that the actuator be positioned by an analog signal (such as 4-20 ma), but where frequent repositioning will not be encountered. The limiting factor with the Modutronic 40 is the electromechanical reverser. Processes which vary continuously from minute to minute, and thus require repositioning of the valve controlling that process, will cause repeated actuation of the reverser. This repeated actuation will heavily stress the electrical contacts on the reverser and drastically reduce contact life. Specify the Modutronic 30 or Modutronic 10A for these applications. Processes which vary only occasionally (once or twice an hour) are more suited to the Modutronic 40 system.

2. Actuators with very short stroke times generally are not suited to the Modutronic 40 system. Longer stroke times (greater than 5 minutes) are usually the ideal applications for the Modutronic 40. (This is, of course, subject to the constraints of application note #1.)

3. Where environmental conditions are severe, i.e., extreme temperatures or high vibrations, it may be desirable to locate the Modutronic 40 control board in a remote location from the actuator. In this case, it is necessary to run the three motor power wires, three wires from the feedback potentiometer (in a shielded cable), and three wires for torque and limit switches and overload wiring between the actuator and the remote location.

Ideally the control wiring should be run separately from the power wiring. Five more wires are required for the integral selector switch and pushbuttons.

4. In situations where it is critical that the flow rate or other parameter controlled by the valve remains constant when the process control signal is lost due to component failure, or some such anomaly, it is desirable to specify the lock-in-last position option. This option will cause the actuator to remain in the position called for by the last valid position-demand signal before the anomaly occurred.

If it is necessary that the valve move to a preset position upon loss of position-demand signal, specify the lock-in command potentiometer position option.

SELECTION CHART

MOTOR TORQUE (FT. LBS.)

Application	2-10	15-25	40-80	100-200
Weatherproof	Mod 10A	Mod 30-3	Mod 30-10	Mod 30-25
Explosion Proof	Mod 30-1	Mod 30-3	Mod 30-10	Mod 30-25
Submersible	Mod 30-1	Mod 30-3	Mod 30-10	Mod 30-25
Low Cycle Rate	Mod 40-1	Mod 40-3	Mod 40-10	Mod 40-25

Note: For Information Regarding Mod 30/Mod 10 Refer To Specific Bulletin.

MODUTRONIC 40

ENGINEERING AND PERFORMANCE SPECIFICATION

FEATURES:

Standard unit operates 3 phase motors with locked rotor currents up to 192 amps and full load currents up to 64 amps (approximately 200 ft lbs). Larger units are available on special order.

Can be mounted inside limit switch compartment on all units SMB-000 and larger.

Allows control by analog signal from almost all process controllers.

Totally solid state comparator circuit.

Cooling: The main control board requires no special cooling measures other than that of insuring that maximum ambient temperature is not exceeded.

ELECTRICAL CHARACTERISTICS:

Line Voltage

3 phase power – Voltage depends on the rating of motor supplied with actuator (typically 460 volts). The reverter is capable of handling up to 525 volts ±10%.

Control voltage – 120 vAC ±10%. The Modutronic 40 system is normally supplied with a built in control voltage transformer with its primary connected between two phases of the 3 phase line. The main control board terminals are then connected to the 120 volt transformer secondary.

Line Current

Maximum line current depends upon size of the motor supplied with the actuator. The only other limiting factor for current is the rating of the electromech. reverser (power output). Standard units are capable of handling locked rotor currents up to 192 amps. Higher current capacities are available on special order units.

SIGNAL INPUTS:

Set Point Input:

Current mode: 1. From any controller providing milliamp current in a range of 1 to 50 milliamperes. 2. Calibrating resistors for current signals.

Input Current Range	Resistor Value
1 to 5 ma	1000 ohms
2 to 10 ma	500 ohms
4 to 20 ma	250 ohms
5 to 25 ma	200 ohms
10 to 50 ma	100 ohms

Voltage mode: 1 to 5 volts standard. For other voltages consult factory.

Command potentiometer: 0 to 1000 ohm pot.

Feedback Input: 0 to 1000 ohm potentiometer sweeping 750 ohms standard. For other feedback modes consult factory.

Pushbutton or selector switch connected to main control board to allow manual operation of actuator.

OUTPUT: The output of the Modutronic 40 System is controlled 3 phase power with a voltage of 220 to 480 volts A.C. Currents of up to 192 amperes locked rotor and 64 amperes full load may be controlled. Larger current capacities are available on a special order basis.

ENVIRONMENT:

Satisfactory operation will be obtained under the following environment conditions:

Temperature, centigrade
−20° to +70°C

Storage temperature, centigrade
−40° to +100°C

Storage temperature, fahrenheit
−40° to +212°F

Humidity, relative
0−95%

Altitude, mean sea level
−200 – +10,000 feet

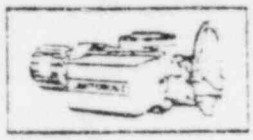
Limitorque B.V.
P.O. Box 155
Cuyk (N.B.), The Netherlands
Phone 31-8850-15714 Telex 37279

Limitorque/Nippon Gear Co., Ltd.
7 Kinharo-Cho
Fujisawa Kanagawa-Ken, Japan
Phone 0466-44-3211 Telex 3862-287

Limitorque Corporation
5114 Woodall Road
Lynchburg, Virginia 24502
(804) 528-4400
Telex 82-4448

LIMITORQUE CORPORATION

5114 Woodall Road • P. O. Box 11318 • Lynchburg, Virginia 24506
Telephone—804-528-4400 • Telex—82-9448



Reply to:
DRIVE SYSTEMS INC.
5333 River Road
New Orleans, La. 70123
Phone: 504-733-8375

July 19, 1982

L P & L
Waterford III
P.O. Box B
Kilona, LA 70066

Attention: Mr. Dick Rose
Mechanical Maintenance Department

Dear Mr. Rose:

In response to your request, we are enclosing a copy of our bulletin no. 18-57 which includes a drawing and parts list for your W-2 manual valve operator. Please not that your unit has a 32:1 worm gear ratio and a spur gear attachment with a 4:1 ratio.

We hope this information will be useful to you. If you have any questions or if we can be of any further service, please call us.

Yours very truly,

LIMITORQUE CORPORATION

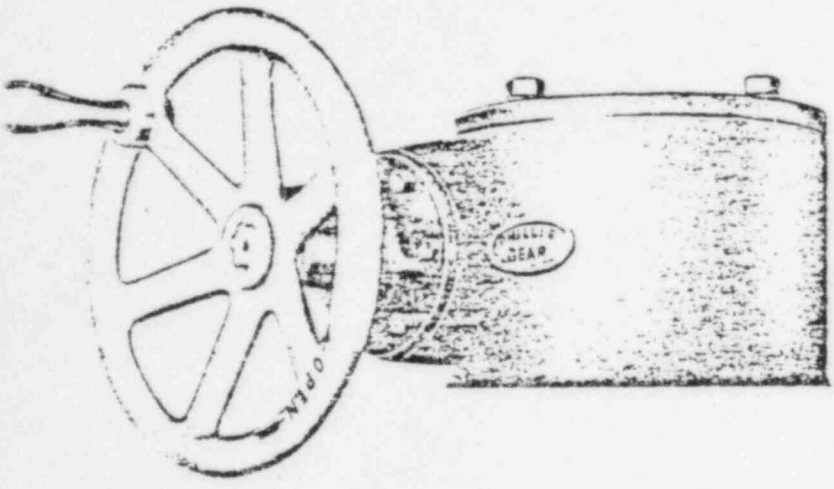
Thomas B. Ferguson

TBF/as

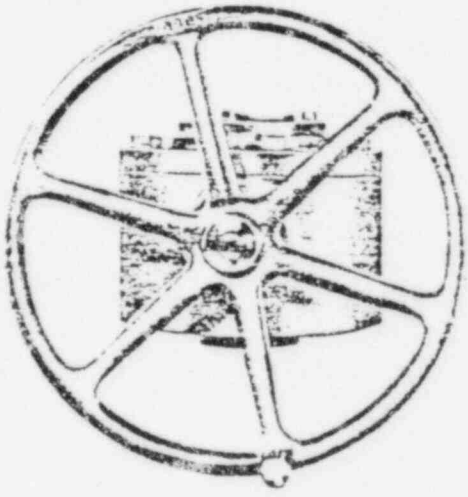
Enclosure

PHILADELPHIA

TYPES W & B MANUAL OPERATORS
(HAND OPERATED UNITS)



TYPE W (WORM GEAR) MANUAL OPERATOR



TYPE B (BEVEL GEAR) MANUAL OPERATOR

For valves, sluice gates, heavy doors or other mechanisms which must be controlled manually but requiring a mechanical advantage between the handwheel and the valve stem or input shaft, LimiTorque provides the "W" (WORM GEAR) or "B" (BEVEL GEAR) units.

Both types of manual units are completely interchangeable with the type SMA, SA and HM LimiTorque motor drive units and therefore will use the same valve yokes, stem nuts and valve stems. Torque and thrust ratings are exactly the same as for the comparable size motor units. This will also allow for future motor operation without any valve changes.

Handwheels are normally furnished with these units. Available handwheel sizes are listed in following tabulations.

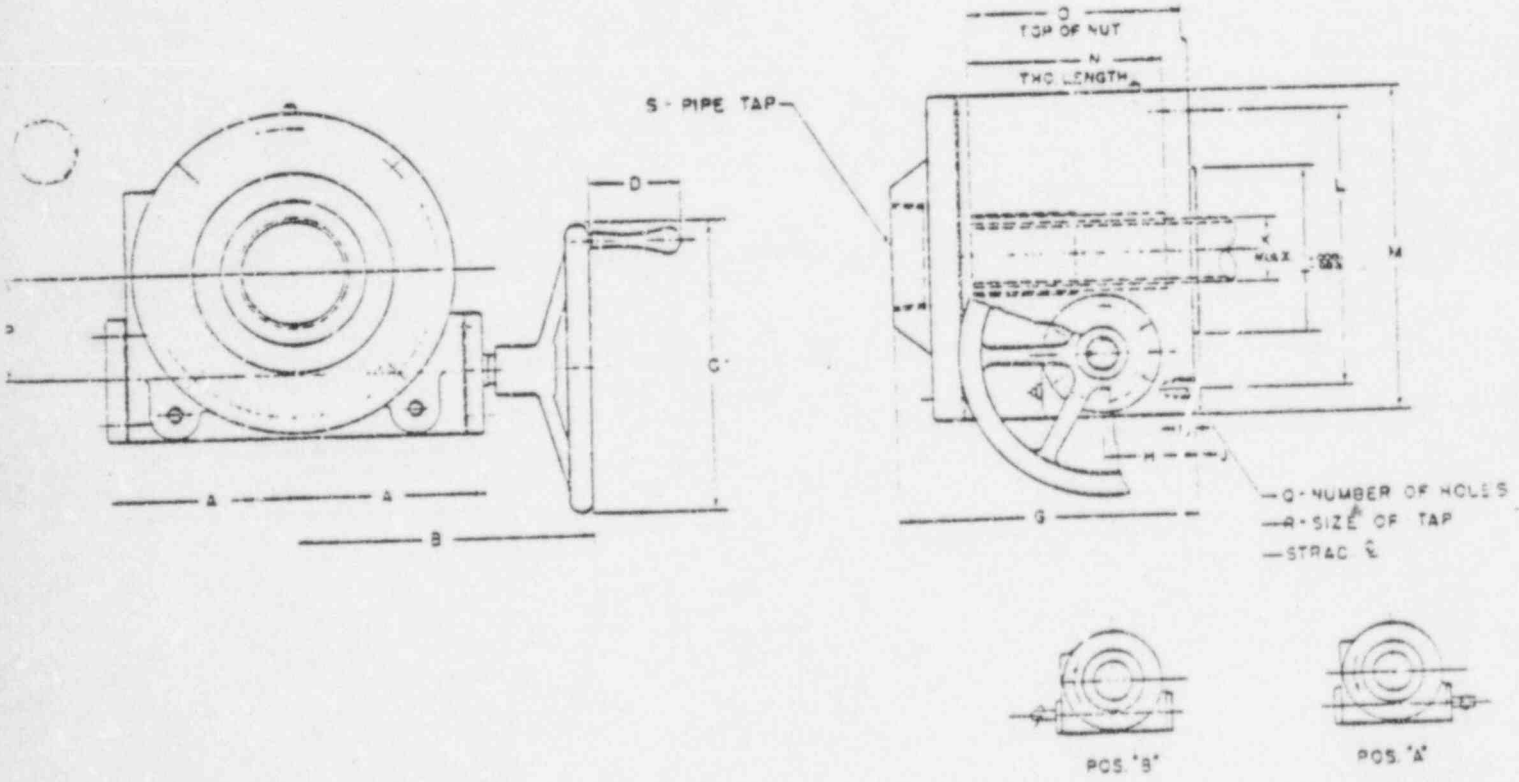
Where necessary an additional gear set can be added at the unit input shafts to reduce handwheel effort. These are available in spur gearing providing for parallel shaft operation or in bevel gearing for right angle operation.

Handwheel operation is always clockwise to close with left hand valve stem threading unless otherwise specified. Hammerblow feature is designed into all units and units are available with mechanical position indicator, duplicating those furnished with our LimiTorque type SMA motor units.

TYPE W (WORM GEAR) MANUAL OPERATOR

SIZE	RATING TORQUE #	RATING THRUST #	*AVAILABLE HW SIZES	**STD WORM GEAR RATIOS	ADDITIVE INPUT SHAFT GEAR RATIO
W0	330	18,000	12"	12.3 : 1 30 : 1 45 : 1	
W1	550	35,000	12" & 18"	14 : 1 32 : 1 63 : 1	4 : 1
W2	1250	50,000	18"	16 : 1 32 : 1 57 : 1	4 : 1
W3	3300	100,000	18" & 24"	10.3 : 1 16 : 1 41 : 1 57 : 1	6 : 1
W4	4300	150,000	24" & 36"	11.6 : 1 17.5 : 1 45 : 1 53 : 1	6 : 1

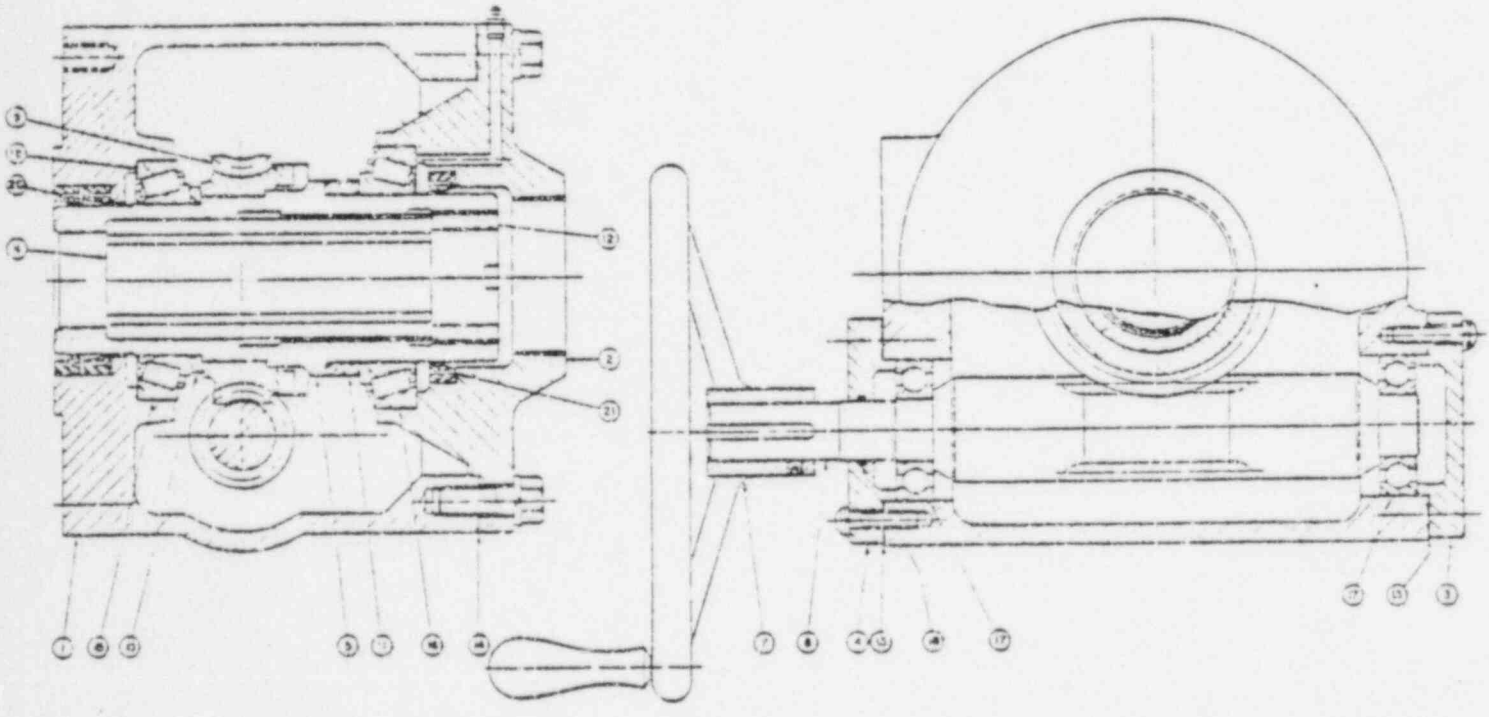
*Smallest diameter handwheel listed is STD.
**Other ratios available depending on stroke needs.



POS. "B"

POS. "A"

UNIT SIZE	A	B	C	D	G	H	J	K	L	M	N	O	P	Q	R	S	T	U
W-0	5 3/8	9 1/4	12	4	10	3 11/16	3/4	1 13/16	6 1/2	8 1/2	6 1/8	7 1/8	2 1/2	4	3/4—10	2 1/2	5	
W-1	6 5/8	11 1/8	12	4	11 3/16	4	3/4	2 1/4	10	11 1/8	7 3/8	8 3/8	3 1/2	8	1—11	3	6	
W-2	7 13/16	12 3/8	18	4	12 1/2	3 13/16	3/4	2 1/4	11 3/4	12 1/2	8 1/4	9 1/8	4 1/4	8	1—10	4	7	
W-3	9 1/16	13 7/16	18	4	13 13/16	5 1/2	3/4	3 1/2	14	16	9 7/8	10 3/4	5	8	1—9	5	8 1/2	1
W-4	10 1/16	14	24	4	16 1/2	6 1/2	7/8	4 1/2	16	18 1/2	11	12 3/4	7	8	1 1/4—7	6	9	1 1/2



PARTS LIST

ITEM NO.	NAME
1	HOUSING
2	HSG COVER
3	END COVER (BLIND)
4	THRU CAP
5	DRIVE SLEEVE
6	STEM NUT
7	HANDWHEEL

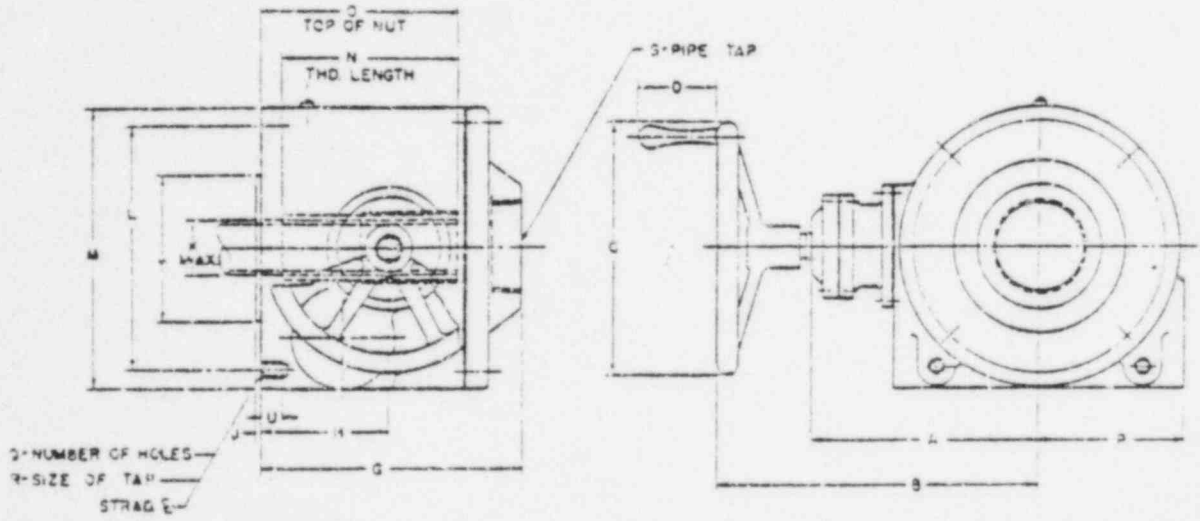
ITEM NO.	NAME
8	WORM SHAFT
9	WORM GEAR
10	W.G. SPACER
11	TOP BRG SPACER
12	LOCKNUT
13	BEARING CAP GASKET
14	HSG COVER GASKET

ITEM NO.	NAME
15	LOWER DR SL BEAR'G
16	UPPER DR SL BEAR'G
17	BALL BEARING
18	O RING
19	SHIM SET
20	HSG OIL SEAL
21	HSG COV OIL SEAL

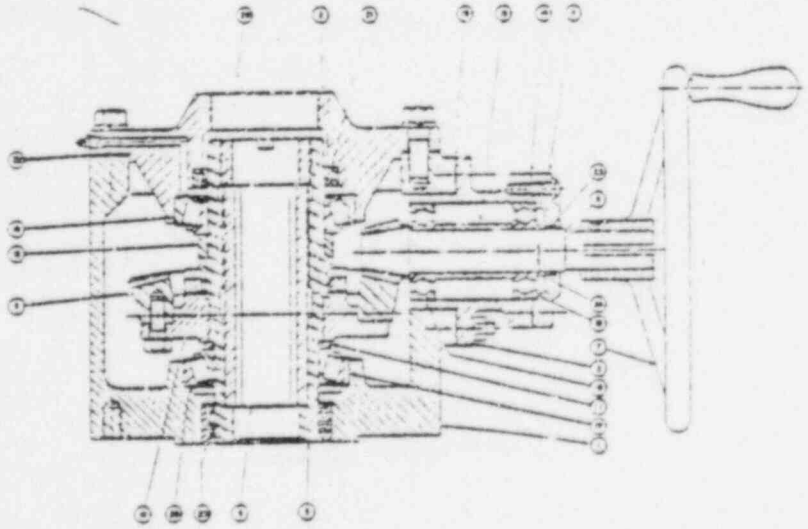
TYPE B (BEVEL GEAR) MANUAL OPERATOR

SIZE	RATING TORQUE =	RATING THRUST =	*AVAILABLE HW SIZES	GEAR RATIO	ADDITIVE INPUT SHAFT GEAR RATIO
00	300	18,000	12"	4 : 1	
01	550	35,000	12" & 18"	5 : 1	4 : 1
02	1250	50,000	18"	5 : 1	4 : 1
B3	3000	100,000	18" & 24"	5 : 1	6 : 1
B4	4000	150,000	24" & 36"	6 : 1	6 : 1

*Smallest diameter handwheel listed is standard.



UNIT SIZE	A	B	C	D	G	H	J	K	L	M	N	O	P	Q	R	S	T	U
B-0	7 13/64	12	12	4	10	5 7/16	3/4	1 13/64	6 1/2	8 1/4	5 1/16	7 1/4	4 11/32	4	3/4 — 10	2 1/2	5	1
B-1	9 1/2	13 3/8	12	4	11 5/64	6	3/4	2 1/4	10	11 3/8	7 3/4	8 3/32	6 1/8	8	1/2 — 11	3	6	1
B-2	10 5/16	14 7/8	18	4	12 1/2	6 3/4	7/8	2 3/4	11 3/4	13 1/2	8 1/4	9 1/4	7 3/4	8	3/4 — 10	4	7	1
B-3	12 1/4	16 3/4	18	4	13 13/64	7 1/8	1	3 1/2	14	16	9 7/8	10 3/8	8 7/8	8	1 — 9	5	8 1/2	1 1/4
B-4	13 1/2	17	24	4	16 3/8	8 1/8	1 1/4	4 1/2	16	18 3/4	11	12 3/8	9 11/16	8	1 1/4 — 7	6	9	1 1/8



ITEM NO.	NAME
1	HOUSING
2	HOUSING COVER
3	PINION SHAFT CARTR.
4	CARTRIDGE CAP
5	DRIVE SLEEVE
6	STEM NUT
7	HAND WHEEL

ITEM NO.	NAME
8	BEVEL PINION SHAFT
9	BEVEL RING GEAR
10	BEVEL GEAR SPIDER
11	BEVEL GEAR SPACER
12	TOP BEARING SPACER
13	PINION SHAFT SPACER
14	CARTR. CAP GASKET

ITEM NO.	NAME
15	CARTR. GASKET
16	UPPER DR. SL. BRG.
17	LOWER DR. SL. BRG.
18	BALL BEARING
19	BALL BEARING
20	HOUSING OIL SEAL
21	HOUSING COV. OIL SEAL

ITEM NO.	NAME
22	HOUSING COV. GASKET
23	O RING
24	RETAINING RING
25	LOCK NUT
26	SHIM SET

PHILADELPHIA GEAR CORPORATION
KING OF PRUSSIA (SUBURBAN PHILA.), PENNA.
Offices in all Principal Cities

DELIVERY SCHEDULE	LIMITORQUE CORPORATION	ORDER NO.
8-9-76		394811-B
QUANTITY	UNIT SIZE & TYPE	CUST. ORDER NO.
11	W-2 MANUAL	C0971OA-ADD1

ASSEMBLY POS. "A"

TAG:
STOCK NO. 80226, S.J. ITEM 39 () EACH: 6CD-V311, THRU 321

NO. REQ'D.	PART NO.	DESCRIPTION	MATERIAL	MAKE STOCK BUY	REMARKS
11	———	W-2 MANUAL 32:1 RATIO		S	
11	60-406-0091-3	WORM SHAFT	ANODIZED	M	
11	B-308188	WORM GEAR	BRZ	M	NO LOST MOTION
11	———	9:1 SPUR GEAR			SHEET 2
11	60-509-0195-9	18" DIA. HANDWHEEL	C. IRON		
11	P-90	STEM NUT			CUSTOMER TO TAP

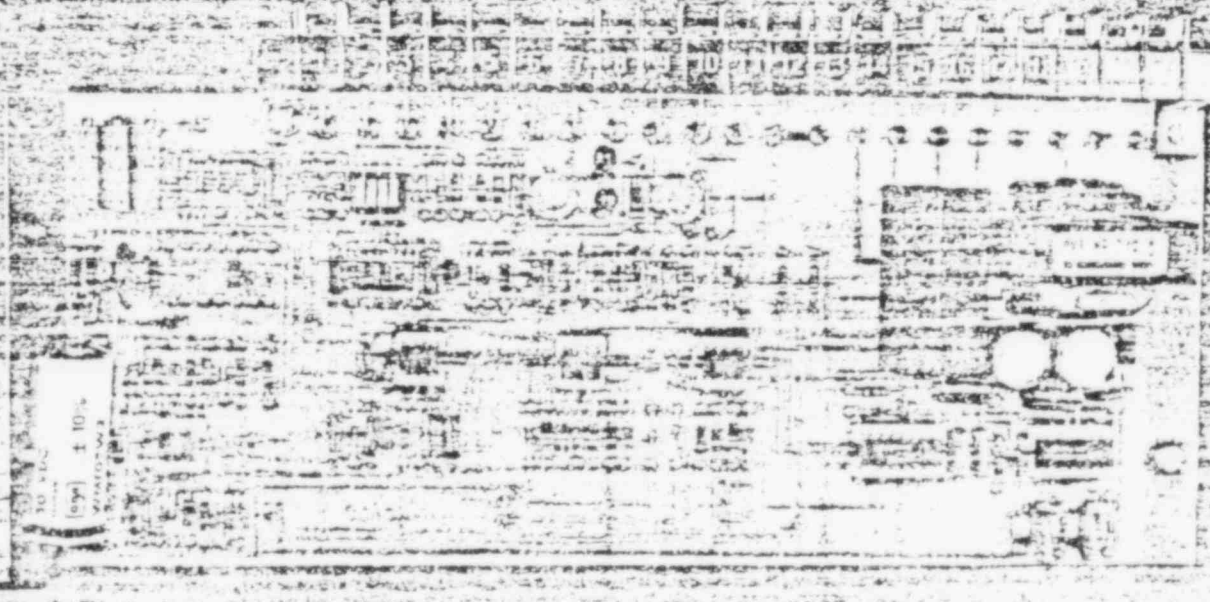
DRAFTSMAN	CHECKED BY	
C.	OK	DEC 26 '95

SHEET 1 OF 2 SHEETS

LIMITORQUE MODUTRONIC 30 & 40

INSTRUCTION AND MAINTENANCE MANUAL

SMB & SMC ACTUATORS



A PRODUCT OF LIMITORQUE® CORPORATION

SMB ACTUATOR INITIAL CHECK-OUT

ead instructions completely before ttempting to calibrate or troubleshoot ese units.

or the Modutronic 30 or Modutronic 40 operate properly, it must be wired rrectly to actuator limit and torque witches, feedback potentiometer, actuator motor, command signal selector switch, and pushbuttons if supplied.

The basic wiring to these devices is shown in the typical wiring diagrams included in this procedure. However, you must refer to the wiring diagram specifically assigned to your actuator to assure that all wiring is correct.

Two separate terminal strips are normally provided within the limit switch compartment, one for three phase power and one for signal wiring. External wiring to the Limitorque actuator will be accomplished by connections at these terminal strips.

CONTROL SIGNAL WIRING

escription of internal wiring is provided as an aid to checkout and maintenance; these connections will have already been made the factory.

IMIT SWITCHES:

iring is based on whether an increasing decreasing signal is to open the valve ee assigned wiring diagram.)

If command signal INCREASES to Open the valve, the open direction limit switch and torque switch are connected in series to Terminal 17 and the close direction limit and torque switch are connected in series to Terminal 15 on the comparator board.

If command signal DECREASES to open the valve, the open direction limit switch and torque switch are connected in series to Terminal 15 and the close direction limit switch and torque switch are connected in series to Terminal 17 on the comparator board.

EEDBACK OTENTIOMETER /IRING:

er is connected to Terminal 7 and end minals are connected to Terminals 6 and 8 on the comparator board. Proper connection of end terminal wires is discussed later in these instructions.

COMMAND SIGNAL WIRING:

All signal wires are to be free of electrical noise and interference. It is highly recommended that all signal wires be run in shielded cable.

A. Milliamp Command Signals: Connect "+" to Terminal 10 and connect "−" to Terminal 13 on the signal terminal strip.

Check removable calibrating resistor installed between Terminals 10 and 13 on the comparator board. It should be of the following value:

If command signal is:	Calibrating resistor value is:
1 to 5 milliamps	1,000 ohms
2 to 10 milliamps	500 ohms
4 to 20 milliamps	250 ohms
5 to 25 milliamps	200 ohms
10 to 50 milliamps	100 ohms

For other values of milliamp signal, use the equation: 5 volts divided by MAXIMUM milliamp value = ohms for calibrating resistor.

B. Voltage Command Signals: For 1 to 5 volt signals, connect "+" to Terminal 10 and "−" to Terminal 13 on the signal terminal strip. For all other voltages consult Limitorque factory representative.

C. Potentiometric Command Signals: Command pot should be 0 to 1000 ohms. Connect it to the signal terminal strip as follows:

1. Connect slider to Terminal 10.
2. Connect "CCW" terminal to Terminal 11.
3. Connect "CW" terminal to Terminal 9.

Note: With this connection, the valve will open upon turning the command pot shaft clockwise. If the opposite action is desired, reverse the connections at Terminals 9 and 11.

Note that only one type and value of command signal may be connected to the Modutronic at any one time. If more than one command signal is required, see the wiring diagram assigned to your order for proper connections.

CONTROL ELEMENTS

Standard/Optional

"Auto-Manual" Selector Switch (Standard)

elector switch is wired across Terminals 1 and 2. When selector switch is in manual" position, there is a connector between 1 and 2. When selector switch is in "auto" Terminals 1 and 2 are not connected. The effect of this switch is to widen the deadband to 00% so that the feedback signal will not effect the output of the Modutronic. his allows handwheel or pushbutton operation when the switch is in the manual position.

B. "Auto-Off-Manual" Selector Switch (Optional)

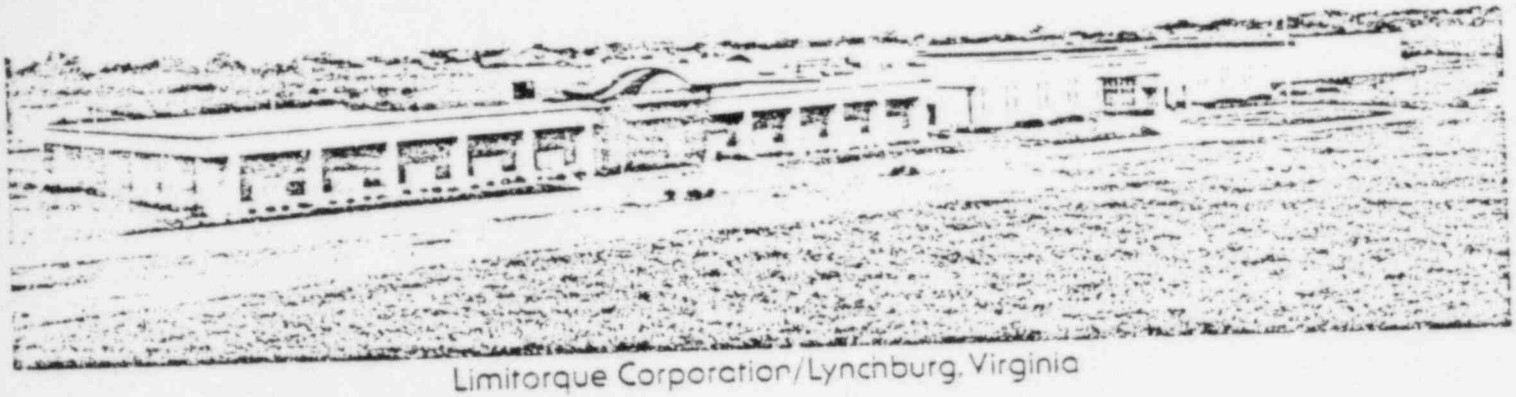
Connected as above. In addition, there is a contact wired in the common line from the comparator board to the solid state reverser (Modutronic 30) or electromechanical reverser (Modutronic 40) which, when opened, prevents motor operation.

C. "Open-Stop-Close" Selector Switch (Optional)

This switch allows manual operation of the actuator without the requirement that a button be held in to continue the operation of the actuator.

D. "Open-Close" Pushbuttons (Optional)

These pushbuttons allow operation of the actuator manually. The buttons must be held in to continue operation of the actuator.



Limitorque Corporation/Lynchburg, Virginia

Your Limitorque Valve Control...

Limitorque is the most advanced valve control on the market ... the result of many years of constant improvement and development. This booklet has been prepared to help you obtain the most benefit and use from your Limitorque valve controls. It contains instructions on the installation and maintenance of these units, plus helpful suggestions enabling you to become thoroughly familiar with the location and proper use of operating controls. Before you do anything, be sure to read this booklet through at least once, then always keep it handy for ready reference.

Limitorque controls the opening and closing travel of the valve and limits the torque and thrust loads with its torque limit switch. As a result, all valve operating parts are protected from overload, improper seating, and foreign obstructions.

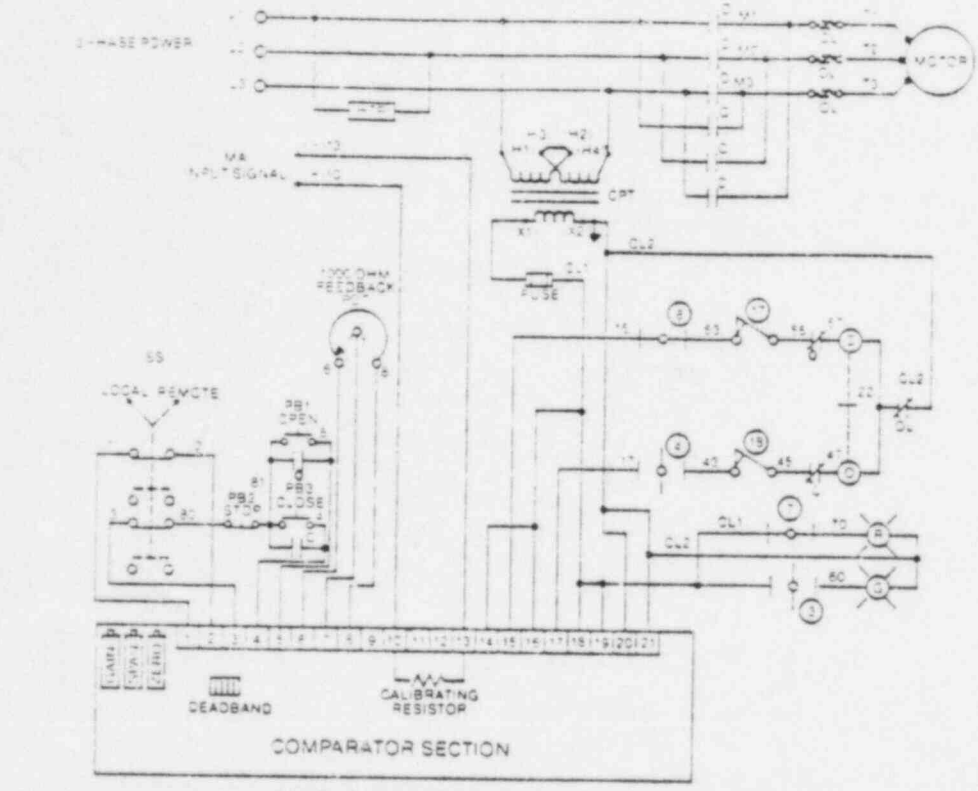
Limitorque controllers may be mounted on any size valve in almost any position or location. Readily adaptable to existing equipment, Limitorque can be actuated by electricity, hydraulic pressure, air or natural gas.

Where to Find Information

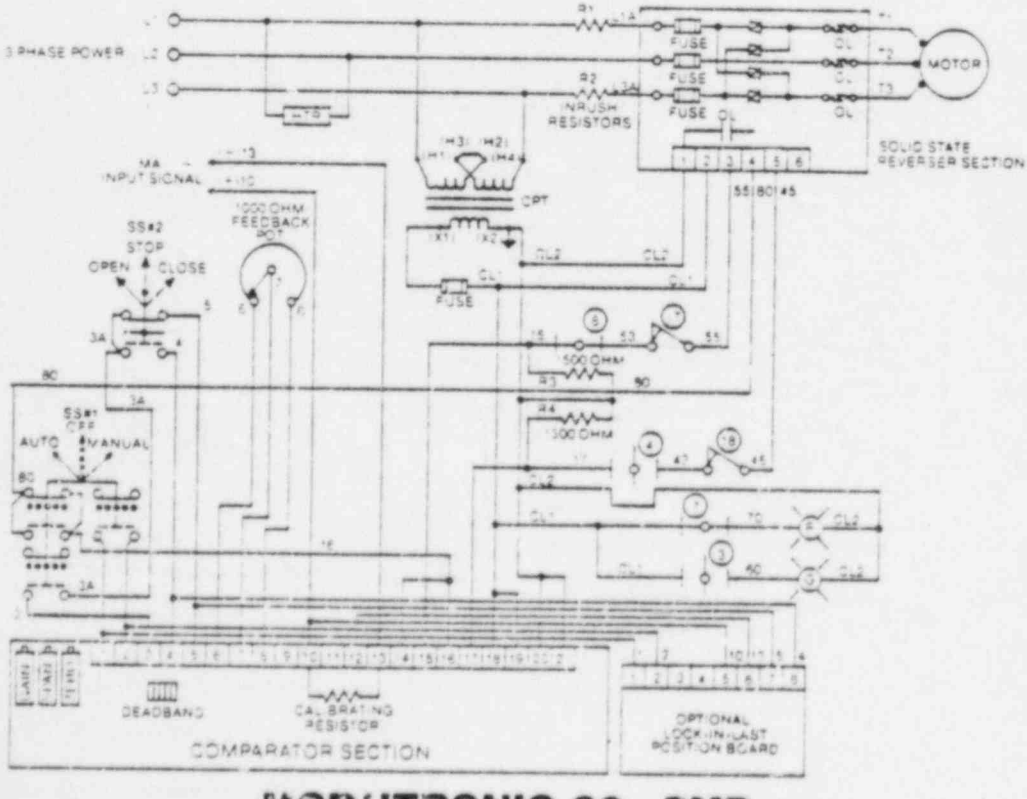
SMB ACTUATORS

SMC ACTUATORS

TYPICAL WIRING DIAGRAMS

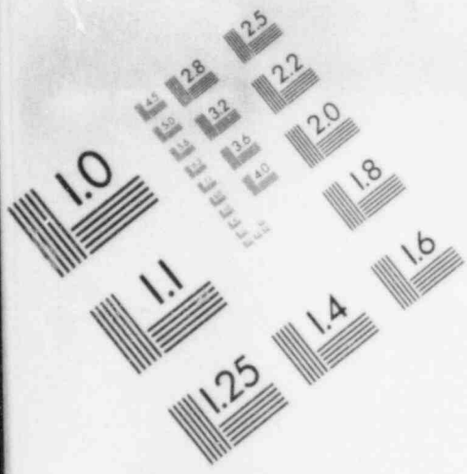


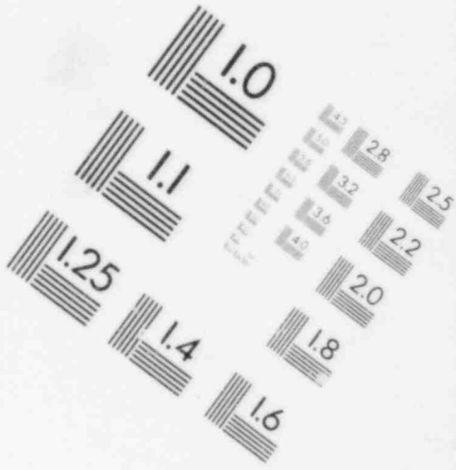
MODUTRONIC 40–SMB

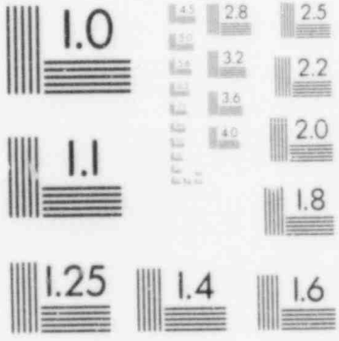


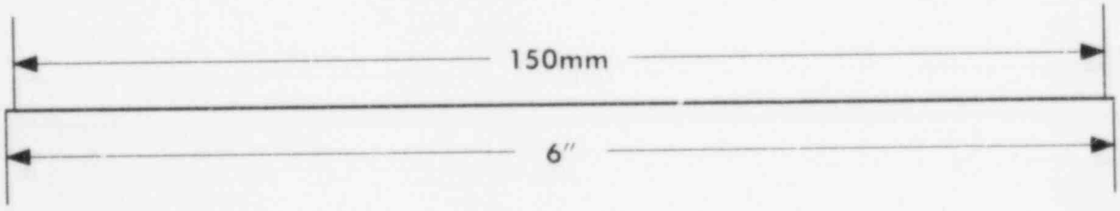
MODUTRONIC 30–SMB

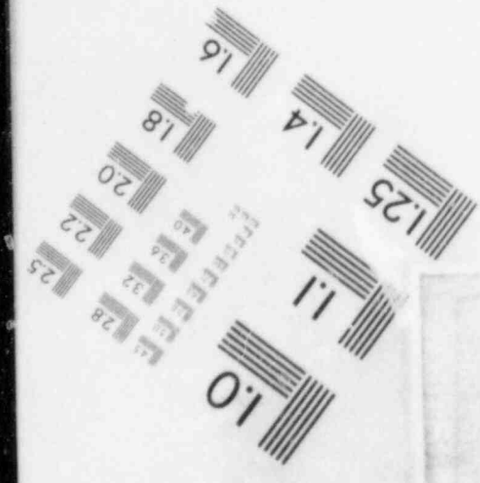
IMAGE EVALUATION
TEST TARGET (MT-3)

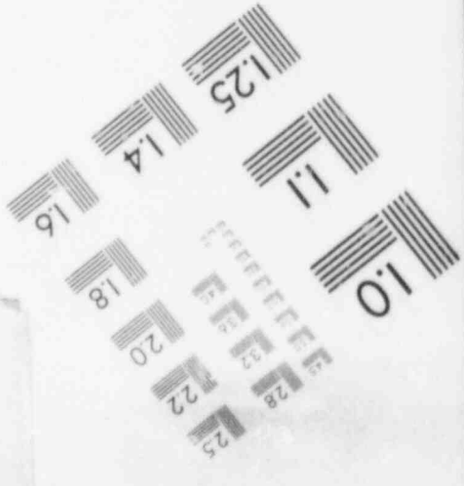










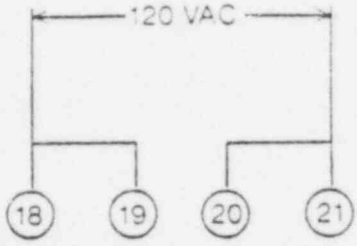


SMB

POWER CONNECTIONS

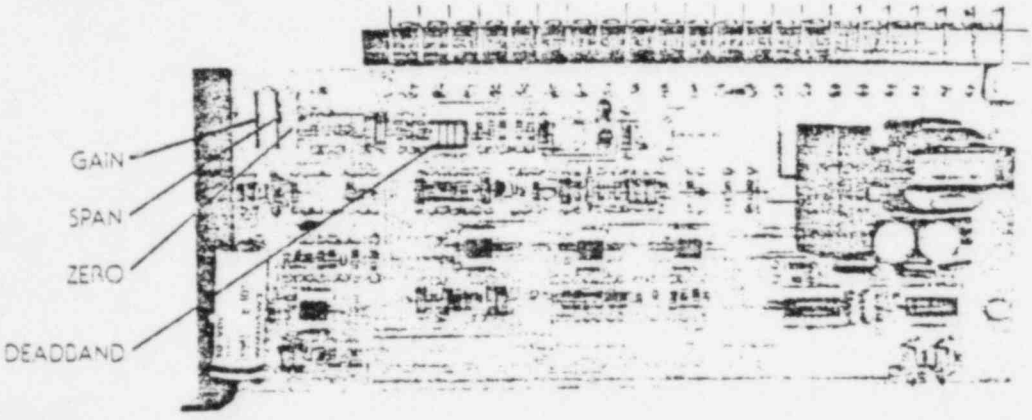
The comparator board accepts single phase 120 volt power. Comparator board power connections are as shown below.

Before connecting power, it should be confirmed that the proper jumpers are installed.



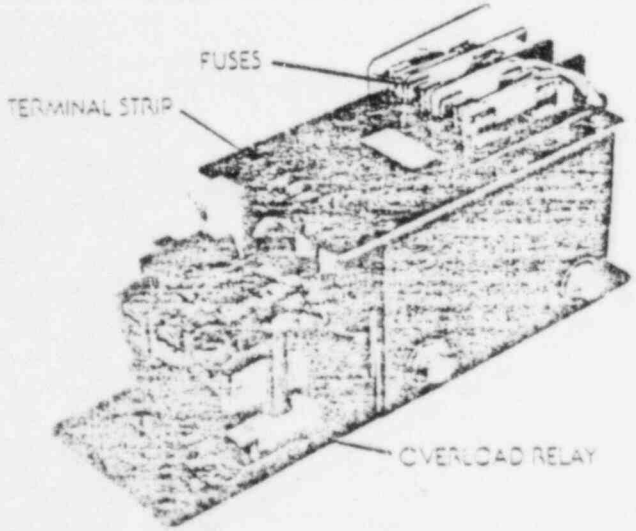
The three phase power supplied to the separate terminal strip marked L1, L2 and L3 may be up to 480 volts. The nominal voltage applied should be within ± 10% of the rated voltage for which the motor is connected. (See motor nameplate.)

MODUTRONIC 30 & 40 COMPARATOR BOARD



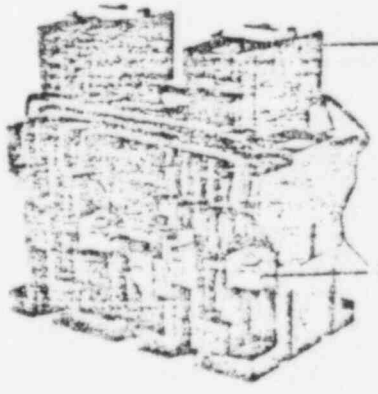
SOLID STATE REVERSER

Modutronic 30



ELECTRO MECHANICAL REVERSER

Modutronic 40



ules on units with a short operating time. Care should be taken especially on units with longer operating times that the duty cycle of the motor is not exceeded.

B. Deadband switches normally are set so that the actuator will not track variations of less than ± 5% in the process control signal. Minimum deadband is usually a satisfactory setting, but if the actuator oscillates (seems to "hunt" or continually move back and forth slightly) while following the set point process controller signal, it may be necessary to use a higher deadband setting. If the actuator approaches the set point, overshoots, hunts back and forth for a short time and then settles down, a higher gain setting may be needed. (Turn gain pot counterclockwise.) (See Section C for a more complete explanation of gain action if this occurs.)

With deadband switch 1 set to "on" deadband width is minimum ± 5%. If another, wider deadband percentage is needed, refer to the table below for deadband switch settings.

For this deadband %	set these switches "on"
± .5	1
± 1.0	2
± 1.5	1 2
± 2.0	3
± 2.5	3 1
± 3.0	3 2
± 4.0	3 2 1
± 5.0	4
± 6.5	4 1
± 7.0	4 2
± 7.5	4 2 1
± 8.5	4 3
± 9.0	4 3 1
± 9.5	4 3 2
± 10.0	4 3 2 1

Note: If all switches are off, deadband is zero. This is almost always an unstable setting and generally should not be used.

C. Function of the Gain Adjustment
The gain adjustment is used to assure stable operation of the Modutronic 30 (40) — Limitorque actuator system. With the gain potentiometer fully clockwise, the gain is minimum and the actuator will run continuously up to the set point before power is removed from the motor. With higher speed units, some overshoot may occur with this gain setting. To correct this, the gain potentiometer should be turned a small amount counterclockwise and the unit tested for proper operation. Continue adjusting the gain in small increments until the unit stops on the set point without overshoot.

As the gain is increased, the Modutronic will begin to pulse the motor on and off as the set point is approached. As the actuator approaches the set point, the rate at which the Modutronic pulses on the motor decreases. When the actuator reaches the set point, or is within the deadband width of the set point, the motor is turned completely off. Increasing the gain setting even more will cause the Modutronic to go into the pulsing mode farther from the set point and thus cause the actuator to approach the set point more slowly. On units with longer operating times, care should be taken not to use too low a gain setting as this will cause long periods of on-off pulsing. Generally, the lowest gain setting that gives no over shoot is recommended.

D. 1. Modutronic 30 — The Solid State Reverser. (See photo page 4)
The solid state reverser is controlled by the main control board and provides the power handling capability of the system. The reverser has three in-line fuses which are sized to protect the triacs. Under normal conditions, it should not be necessary to replace these fuses. If a problem (such as an accidental short from one line to another) should occur and a fuse is blown, it is very important that the fuses be replaced with EXACTLY the same type fuse as was originally supplied.

2. Modutronic 40 — Electromechanical Reverser. (See photo page 4)
Not user servicable. Replace if defective.

SUMMARY OF CALIBRATION PROCEDURE-SMB

See SMBI-170 or SMBI-180 — Set Gear Limit Switches.

Preset:

1. Select manual mode.
2. Gain — CW.
3. Deadband — SW. 2, 3 & 4 off, 1 on.
4. Zero — 8 turns from end point.
5. Span — CCW.

Calibrate:

1. Set minimum input (usually 4 ma.)
2. Select auto mode.
3. Turn zero CCW to limit switch trip point.
4. Set maximum input (usually 20 ma.)
5. Turn span CW to limit switch trip point.
6. Fine tune zero and span.
7. Select minimum deadband for no oscillation.
8. If required — turn gain CCW for no overshoot.

SMB

SET-UP AND CALIBRATION PROCEDURE

The three phase power supplied to the separate terminal strip marked L1, L2 and L3 may be up to 480 volts. The nominal voltage applied should be within ± 10% of the rated voltage for which the motor is connected. (See motor nameplate.)

A. **Presetting** (See Page 4 for location of controls.)

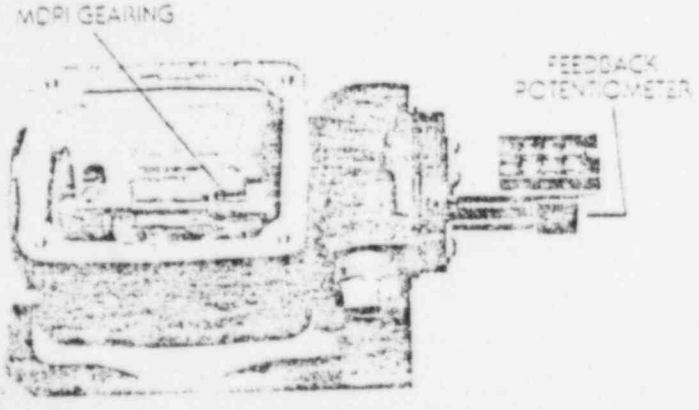
1. **Set open and close limit switches** using instructions found in SMBI-180 or SMBI-170 instruction manual.
2. **Set SELECTOR SWITCH** to "Manual" mode or "Local" or jumper comparator board Terminal 1 to 2.
3. **Turn GAIN adjustment full clockwise.** (These are 15 turn potentiometers which click faintly upon reaching an endpoint. This is minimum gain which results in little or no pulsing to reach set point.
4. **Set DEADBAND switches 2, 3 and 4 to "off" and 1 to "on"** (minimum deadband)
5. **Turn ZERO potentiometer to mid-point.** (approximately 8 turns from endpoint)
6. **Turn SPAN adjustment fully counter-clockwise.** (minimum span)
7. **Place the actuator in mid-travel** using the handwheel.
8. **Run the unit electrically in either the open or close direction for only enough time to verify proper rotation.** This can be accomplished by use of the push-buttons, or if pushbuttons are not supplied by jumpering comparator board Terminal 3 momentarily to Terminal 4 to close the valve or Terminal 3 to Terminal 5 to open the valve.
9. **If the actuator runs in the opposite direction than that expected when the respective terminals are jumpered or buttons pushed, it will be necessary to switch any two power leads where they are connected to the power terminal strip.**
10. **Run the unit to the 50% position.** Turn off power. Read the resistance between comparator Terminal 7 (feedback pot slider) and Terminal 8 (ground). You should read 500 ohms. If you do not get this reading, loosen the set screw on the feedback potentiometer shaft. Turn the shaft until you get the proper reading from Terminal 7 to Terminal 8. **** RETIGHTEN THE SET SCREW ****
11. **Move the valve towards the open position.** Note whether the feedback voltage (D.C. voltage from Terminal 7 (+) to Terminal 12(−).) increases or decreases. If the command signal (in automatic mode) is to increase to open the valve, the feedback voltage should move towards −5 volts. If the command signal is to decrease to open the valve, the feedback voltage should move toward +5 volts. If the feedback voltage moves in the wrong direction upon opening the valve, TURN OFF POWER, reverse the wires on Terminals 6 and 8.

B. Calibration Procedure

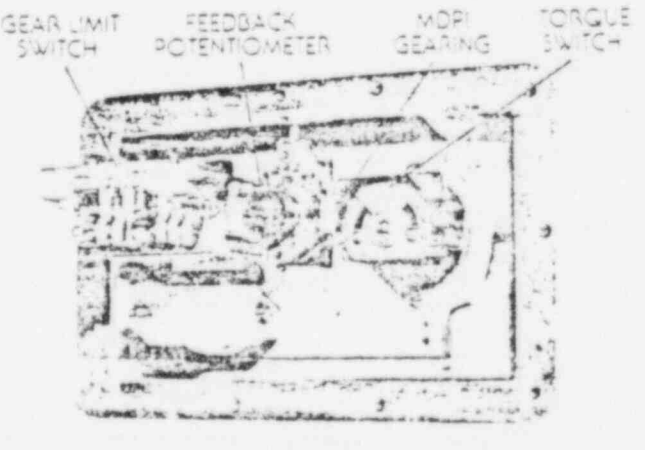
1. **Set the process controller or command potentiometer** to minimum input signal.
2. **Place the unit in "automatic" mode.** The unit may run somewhat toward the position called for by the minimum command signal. This is a normal action due to the fact that the feedback signal now effects the Modutronic. The minimum command signal is compared to the feedback signal and the Modutronic senses a difference. The Modutronic energizes the motor and moves the valve (and thus the feedback pot) until the feedback signal is balanced against the command signal. Changing the zero setting changes the amount that the Modutronic will move the valve toward that position called for by the minimum command signal.
3. **Turn the ZERO control counterclockwise** until the limit switch trips.
4. **Set the process controller or command pot to maximum signal.** The actuator may run toward the position called for by that signal and stop somewhere short of the limit. Now slowly turn the SPAN control clockwise until that limit just trips.
5. **Turn the process controller or command pot back to minimum signal;** allow the unit to run until it stops and "fine tune" the ZERO control for the position where the limit switch just trips.
6. **Turn the process controller or command pot <u>back</u> to maximum signal;** allow the unit to run until it stops and "fine tune" the SPAN control so that the limit switch just trips.
7. **Because the SPAN and ZERO controls effect one another,** it may be necessary to alternate between the maximum and minimum command signal once or twice more and "fine tune" the SPAN and ZERO controls until they are at the correct point. This procedure should only take several min-

MDPI-FEEDBACK POTENTIOMETER

SMB 000/00



SMB 0 AND LARGER



SMC ACTUATOR INITIAL CHECKOUT

Read instructions completely before attempting to calibrate or troubleshoot these units.

For the Modutronic 30 or Modutronic 40 to operate properly it must be wired correctly to actuator limit and torque switches feedback potentiometer motor command signal selector switch and pushbuttons if supplied. The basic wiring to these devices is shown in the typical wiring diagrams of the Modutronic 30 and 40 shown in this procedure. However you must refer to the wiring diagram specifically assigned to your actuator to assure that all wiring is correct.

CONNECTIONS - GENERAL

MODUTRONIC 30

The integral equipment compartment has four terminal strips, one separate nine point strip (designated TB1), one six point strip on the solid state reverser (TB2), and two strips on the comparator assembly, an eight point (TB3), and a fourteen point (TB4). (See figure 1)

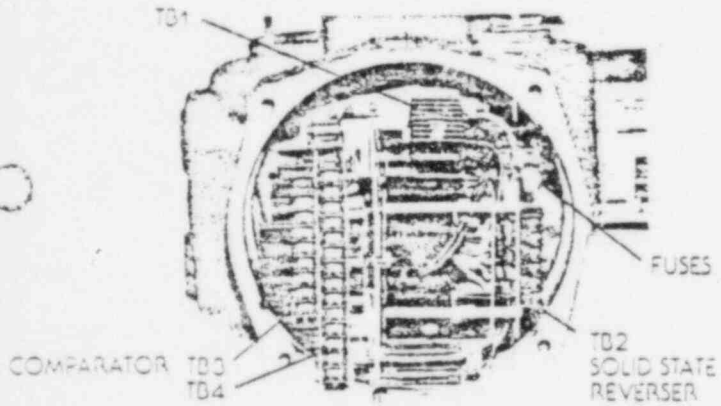


Figure 1 — Modutronic 30 - SMC

MODUTRONIC 40

The integral equipment compartment has the same terminal strips except that there is no solid state reverser strip (TB2). Wiring is direct to the coils of the electromechanical reverser. (See figure 2)

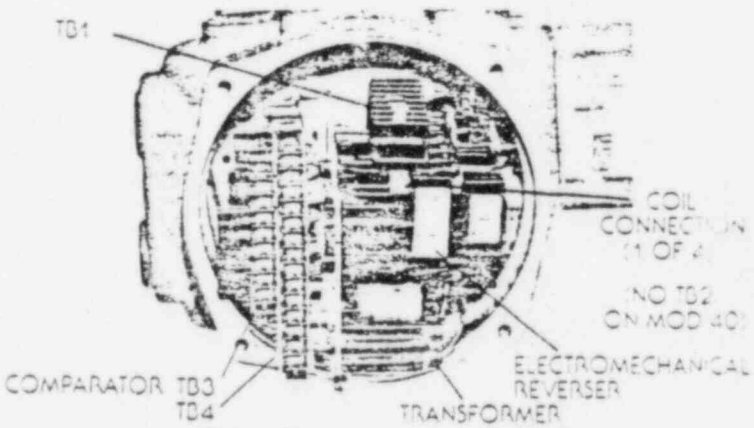


Figure 2 — Modutronic 40 - SMC

MODUTRONIC 30 AND 40 - EXTERNAL CONNECTIONS

External wiring to the Limitorque actuator will be accomplished by connections to the 12 point terminal strip mounted in the geared limit switch compartment.

Internal wiring is normally completely connected at the factory. The description of internal wiring provided herein is intended as an aid to checkout and troubleshooting.

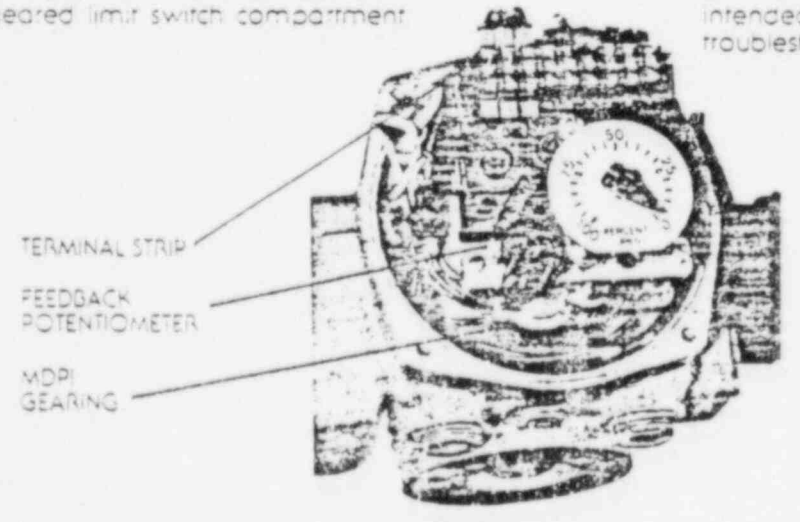


Figure 3 — Geared Limit Switch Compartment Terminal Strip

TROUBLE SHOOTING

MODUTRONIC 30 OR 40 SMB ACTUATORS

If the set up and calibration procedure was followed but proper operation was not obtained, check the following first:

1. Is three-phase power properly connected to the power terminal strip?
2. Is 120 volts A.C. present between terminals 18 and 21 on the comparator board? For the Modutronic 30 120 VAC should also be present between terminals 1 and 2 of the solid state reverser. If not, check the control transformer fuse.
3. Does feedback voltage (from comparator terminal 7 to terminal 12) move in the proper direction on opening the valve? (See Set Up and Calibration Procedure, Presetting—Section No. 11)
4. Is the coupling tight on the feedback potentiometer shaft?
5. Are all wiring connections tight?

Symptom—Operator will not run even in manual mode.

Check input power.
Check solid state reverser fuses. (Modutronic 30 only)
Is overload tripped or are overload heaters missing?

Modutronic 30 only:
Using an insulated jumper (with unit in mid-travel) jumper solid state reverser terminal 4 to either terminal 3 or terminal 5. CAUTION—120 VAC PRESENT ON THESE TERMINALS. If unit now runs, this indicates the solid state reverser is good and that the fuses and overloads are good. The problem may be with the comparator or the wiring from the comparator to the reverser.

Modutronic 30 & 40
With unit energized in the appropriate direction, check for a voltage reading across limit switch terminals 15 to 50 (close) and 17 to 40 (open) and across torque switch terminals 50 to 55 (close) and 40 to 45 (open). If 120 volts (nominal) is present across any one of these terminals, that contact is bad. Consult the Limitorque representative.

If no voltage is present across these contacts, energize the open pushbutton or short comparator board terminal 3 to terminal 5. Now read the voltage across the comparator terminal 16 to 17. If there is 120 volts present, this indicates that the open output solid state relay on the comparator is not operating. Now short comparator board terminal 3 to terminal 4 and read the voltage across comparator terminal 15 to 14. If there is 120 volts present, this indicates that the close output solid state relay on the comparator is not operating. If either one of these conditions occurs, replace the comparator board.

Symptom—When power was applied to the unit, one of the indicator lights on the solid state reverser came on and a fuse blew. (Modutronic 30 only).

This indicates that one of the leakage resistors that is connected between terminal 15 and CL2 or terminal 17 and CL2 is open. Remove and test these resistors. You should read 1500 ohms across each one.

Symptom—Unit will not operate in automatic mode. (Modutronic 30 & 40).

1. Check that when the unit is in automatic mode there is no short circuit between terminals 1 and 2 on the comparator board.
2. Check that the input signal is connected with the positive going to terminal 10 on the comparator board and the negative going to terminal 10 on the comparator board.
3. Check that the proper calibrating resistor for your input signal is installed between terminals 10 and 13 on the comparator board.

Symptom—The full range of the analog input signal does not result in the full valve travel even with maximum span adjustment. (Modutronic 30 & 40).

1. Check span adjustment, zero adjustment.
2. Check for proper calibrating resistor value. (See page 3, Command Signal Wiring.)
3. Check that the analog input signal is of proper value.
4. Check geared limit switch adjustment. (See SMBI-180.)

Symptom—As the actuator follows an input signal, control is erratic throughout the range; that is, the operator will not track the input signal smoothly. (Modutronic 30 & 40).

As the actuator is moved in manual mode from open to close, monitor the feedback voltage from terminal 7 to terminal 12. It should go smoothly from approximately −4.8 volts to +4.8 volts. If the voltage takes a sudden jump from one direction to the other, the feedback pot is adjusted such that it is being driven beyond the end point of the potentiometer. It will then be necessary to loosen the set screw on the feedback potentiometer shaft and readjust the position of feedback potentiometer wiper.

If the voltage is erratic as the actuator moves from open to close, the feedback pot may have become contaminated with dirt. Replace the pot.

Symptom—Large input signal variations result in little or no movement of the actuator. (Modutronic 30 & 40).

Check deadband setting. The deadband switches are a plug in module. It should be plugged in such that switch number one is toward the transformer.

Do not attempt to repair either the solid state reverser section or the comparator section of the Modutronic 30 or the comparator section of the Modutronic 40. This will cancel the warranty if it is in effect.

If the set up and calibration procedure and the troubleshooting procedure are followed and you are still unable to get the Modutronic to operate properly, please call the nearest Limitorque office. Give them the actuator order number and serial number (found on actuator nameplate), and a description of the malfunction.

SMC

CONTROL SIGNAL WIRING

Limit Switch Wiring

Wiring is based on whether an increasing or decreasing signal is to open the valve. (See assigned wiring diagram.)

A. If command signal INCREASES to open the valve, the open direction limit switch and torque switch are connected in series to TB3-7 and the close direction limit and torque switches are connected in series to TB3-8 (on the 8 point comparator board strip).

B. If command signal DECREASES to open the valve, the open direction limit switch and torque switch are connected in series to TB3-8 and the close direction limit switch and torque switch are connected in series to TB3-7 on the comparator board.

Feedback Potentiometer Wiring

Slider is connected to TB4-3 and end terminals are connected to TB4-2 and 4 (on the 14 point comparator board strip). Proper connection of end terminal wires is discussed later in these instructions.

Command Signal Wiring

All signal wires are to be free of electrical noise and interference. It is highly recommended that all signal wires be run in shielded cable. (Signal wires into the integral equipment compartment come from the geared limit switch compartment terminal strip.)

A. **Milliamp Command Signals:** Connect "+" to TB4-11 and connect "−" to TB4-9.

Check removable calibrating resistor installed between TB4-11 and 9 on the comparator board. It should be of the following value:

If command signal is:	Calibrating resistor value is
1 to 5 milliamps	1,000 ohms
2 to 10 milliamps	500 ohms
4 to 20 milliamps	250 ohms
5 to 25 milliamps	200 ohms
10 to 50 milliamps	100 ohms

For other values of milliamp signal use the equation: 5 volts divided by MAXIMUM milliamp value = ohms for calibrating resistor.

B. **Voltage Command Signals:** For 1 to 5 volt signals connect "+" to TB4-11 and "−" to TB4-9 on the 14 point comparator board strip. For all other voltages consult Limitorque factory representative.

C. **Potentiometric Command Signals:** Command pot should be 0 to 1000 ohms. Connect it as follows:

1. Connect slider to TB4-11.
2. Connect "ccw" terminal to TB4-12.
3. Connect "cw" terminal to TB4-10.

Note: With this connection the valve will open upon turning the command pot shaft counterclockwise. If the opposite action is desired, reverse the connections at TB4-10 and 12.

Note that only one type and value of command signal may be connected to the Modutronic at any time. If more than one command signal is required, see the wiring diagram assigned to your order for proper connection.

CONTROL ELEMENTS

(Standard/Optional)

A. **"Auto-Manual" Selector Switch (Standard)** Selector switch is wired from TB4-7 to 8. When selector switch is in "manual" position, there is a connection between 7 and 8. When selector switch is in "auto," Terminals 7 and 8 are not connected. The effect of this switch is to widen the deadband to 100% so that the feedback signal will not effect the output of the Modutronic. This allows handwheel or pushbutton operation when the switch is in the "manual" position.

B. **"Auto-Off-Manual" Selector Switch (Optional)** Modutronic 30—Connected like the auto-manual switch. An additional contact is wired in series with the common on the comparator board (TB3-6) and the solid state reverser (TB2-4) which when opened prevents motor operation.

Modutronic 40—Connected like the auto-manual switch. An additional contact is wired in series with the common on the comparator board (TB3-6) and the common line to the electromechanical reverser coils.

C. **"Open-Stop-Close" Selector Switch (Optional)** This switch allows continuous manual operation without the requirement that a button be held in.

D. **"Open-Close" Pushbuttons (Optional)** Modutronic 30—These momentary contact pushbuttons allow manual positioning of the actuator. Note that a "stop" button is not normally supplied.

Modutronic 40—Pushbuttons can be supplied with holding contacts or in a momentary contact configuration. When holding contacts are supplied, a stop button may also be included.

SMC

POWER CONNECTIONS

Three phase power is to be supplied to the geared limit switch compartment terminal strip (marked L1, L2, L3) and may be up to 480 volts. The voltage applied should be within ±10% of the motor nameplate voltage. Three phase power is distributed within the actuator to TB3 (separate 8 point strip) and from there to the solid state (Modutronic 30 or electromechanical (Modutronic 40 reverser.

SET UP AND CALIBRATION PROCEDURE

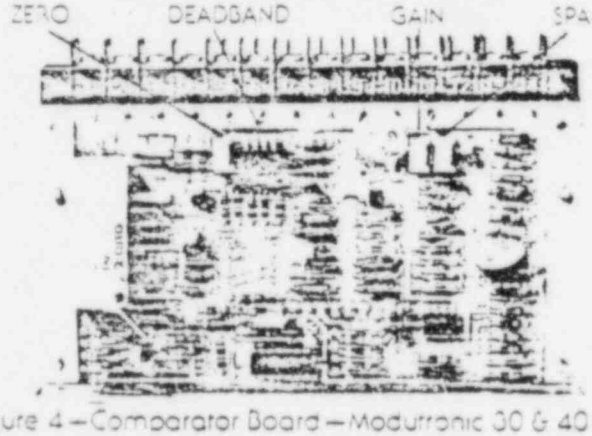


Figure 4—Comparator Board—Modutronic 30 & 40-SMC

A. **Presetting** (See figure 4 photo of comparator for location of controls)

1. With power off, set SELECTOR SWITCH to "manual" mode or "local" or jumper 14 point comparator board TB4-7 to 8.
2. Turn GAIN adjustment full clockwise. (These are 30 turn potentiometers which "click" faintly upon reaching an endpoint). This is minimum gain which results in little or no pulsing to reach set point.
3. Set DEADBAND switches 4, 3 and 2 to "off" and 1 to "on". (minimum deadband)
4. Turn ZERO potentiometer to midpoint (approximately 15 turns from endpoint)
5. Turn SPAN adjustment fully counterclockwise. (minimum span) Now turn back 2 turns clockwise.
6. Set open and close limit switches using the instructions found in SMCI-04/CO-80 instruction manual.
7. Place the actuator in mid-travel using the handwheel.
8. Turn on power. Run the unit electrically in either the open or close direction for only enough time to verify proper rotation. This can be accomplished by use of the pushbuttons. If pushbuttons are not supplied, jumper comparator board TB4-6 momentarily to TB4-14 to close the valve or TB4-6 to TB4-13 to open the valve.
9. If the actuator runs in the opposite direction than that expected, it will be necessary to switch any two power leads where they are connected to the geared limit switch compartment terminal strip.
10. Run the unit to the 50% position. Turn off power. Read the resistance between comparator TB4-3 (feedback pot slider) and TB4-2. You should read 500 ±10 ohms. If you do not get this reading, loosen the set screw on the feedback potentiometer shaft. (See figure 5) Turn the shaft until you get the proper reading from TB4-3 to TB4-2. **RETIGHTEN THE SET SCREW**
11. Move the valve towards the open position. Note whether the D.C. voltage from TB4-3 to TB4-9 (ground) increases or decreases. If the command signal (in automatic mode) is to increase to open the valve, the feedback voltage should move towards +5 volts. If the command signal is to decrease to open the valve, the feedback voltage should move toward −5 volts. If the feedback voltage moves in the wrong direction upon opening the valve, TURN OFF POWER, reverse the wires on TB4-2 and 4. Turn power on and verify proper operation.

B. **Calibration Procedure**

1. Set the process controller or command potentiometer to minimum input signal.
2. Place the unit in "automatic" mode. The unit may run somewhat toward the position called for by the minimum command signal.
3. Turn the ZERO control clockwise until the limit switch trips.
4. Set the process controller or command pot to maximum signal. The actuator may run toward the position called for by that signal and stop somewhere short of the limit. Now slowly turn the SPAN control clockwise until that limit just trips.
5. Turn the process controller or command pot back to minimum signal, allow the unit to run until it stops, and "fine tune" the ZERO control for the position where the limit switch just trips.
6. Turn the process controller or command pot back to maximum signal, allow the unit to run until it stops and "fine tune" the SPAN control so that the limit switch just trips.
7. Because the SPAN and ZERO controls affect one another, it may be necessary to alternate between the maximum and minimum command signal once or twice more and "fine tune" the SPAN and ZERO controls until they are at the correct point. This procedure should only take several minutes on units with a short operating time. Care should be taken, especially on units with longer operating times, that the duty cycle of the motor is not exceeded.
8. Deadband switches normally are

set so that the actuator will not track variations of less than ± 5% in the process control signal. Minimum deadband is usually a satisfactory setting but if the actuator oscillates (seems to "hunt" or continually move back and forth slightly, while following the set point process controller signal, it may be necessary to use a higher deadband setting. If the actuator approaches the set point, overshoots, hunts back and forth for a short time and then settles down, a higher gain setting may be needed. (Turn gain pot counterclockwise). (See Section C for a more complete explanation of gain action if this occurs.)

With deadband switch 1 set to "on" deadband width is minimum ± 5%. If another wider deadband percentage is needed, refer to the table below for deadband switch settings.

For this deadband %	Set these switches "on"
± 5	1
± 10	2
± 15	1, 2
± 25	3
± 30	3, 1
± 35	3, 2
± 40	3, 2, 1
± 60	4
± 65	4, 1
± 70	4, 2
± 75	4, 2, 1
± 85	4, 3
± 90	4, 3, 1
± 95	4, 3, 2
±100	4, 3, 2, 1

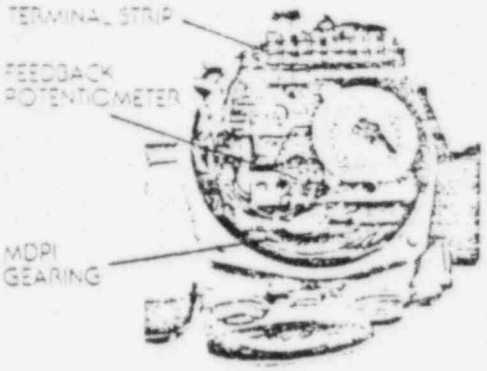


Figure 5—MDPI Gearing and Feedback Potentiometer

Note: If all switches are off, deadband is zero. This is almost always an unstable setting and generally should not be used.

C. Function of the Gain Adjustment

The gain adjustment is used to assure stable operation of the Modutronic 30—Limitorque actuator system. With the gain potentiometer fully clockwise the gain is minimum and the actuator will run continuously up to the set point before power is removed from the motor. With higher speed units, some overshoot may occur with this gain setting. To correct this, the gain potentiometer should be turned a small amount counterclockwise and the unit tested for proper operation. Continue adjusting the gain in small increments until the unit stops on the set point without overshoot.

As the gain is increased, the Modutronic will begin to "pulse" the motor on and off as the set point is approached. As the actuator approaches the set point, the rate at which the Modutronic pulses on the motor decreases. When the actuator reaches the set point (or is within the deadband width of the set point), the motor is turned completely off. Increasing the gain setting even more will cause the Modutronic to go into the pulsing mode farther from the set point and thus cause the actuator to approach the set point more slowly. On units with longer operating times, care should be taken not to use too high a gain setting as this will cause long periods of on-off pulsing. Generally, the lowest gain setting that gives no overshoot is recommended.

D. Power Control

Modutronic 30—The Solid State Reverser

The solid state reverser is controlled by the comparator board and provides the power handling capability of the system. The reverser has three in-line fuses which are sized to protect the triacs. Under normal conditions, it should not be necessary to replace these fuses. If a problem (such as an accidental short from one line to another) should occur and a fuse is blown, it is very important that the fuses be replaced with EXACTLY the same type fuse as was originally supplied.

Modutronic 40—Electromechanical Reverser

The electromechanical reverser is controlled by the comparator board and provides the power handling capability of the system. It includes an overload relay for motor protection. The reverser is not user serviceable.

SUMMARY OF CALIBRATION PROCEDURE - SMC

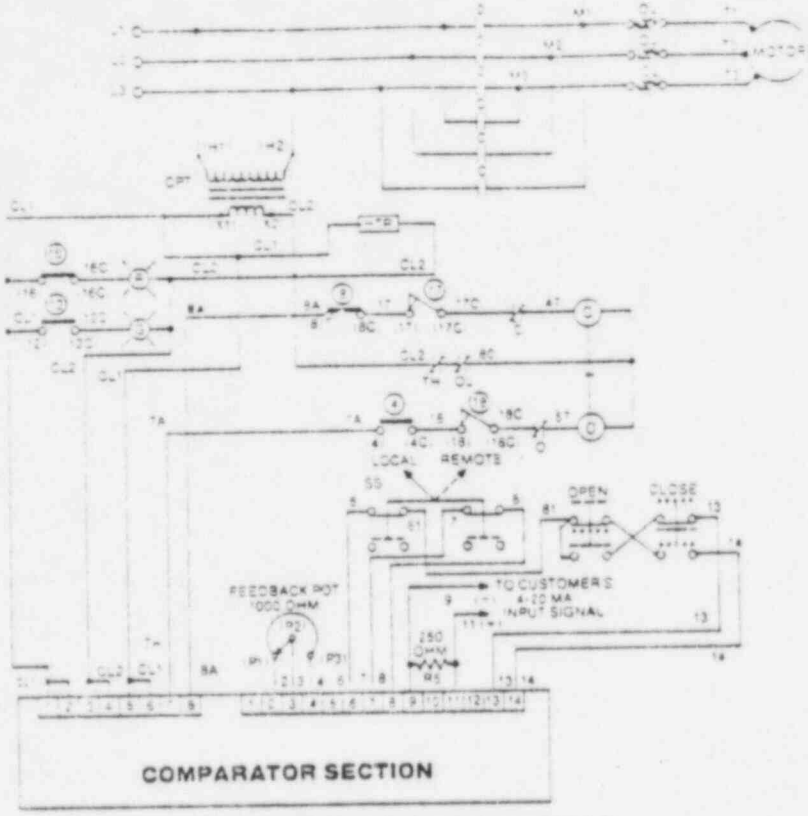
See SMCI 04/00-80, Set Geared Limit Switch.

Preset
1. Select manual mode
2. Gain—CW
3. Deadband—SWITCH 2, 3, and 4 ON
4. Zero—1/8 turns from endpoint
5. Span—CCW. Back CW 2.

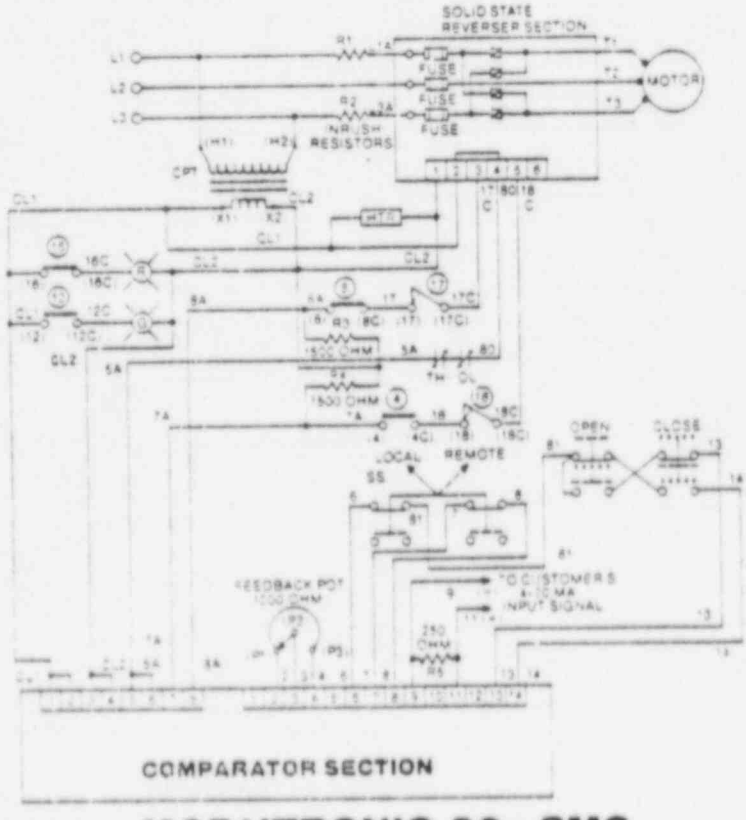
Calibrate
1. Set minimum input (usually 4 MA).
2. Select auto mode
3. Zero—CW to limit switch the point
4. Set maximum input (usually 20 MA)
5. Span—CW to limit switch the point
6. Fine tune zero and span
7. Select minimum deadband for no oscillation
8. If required—turn gain CCW for no overshoot

SMC

TYPICAL WIRING DIAGRAMS



MODUTRONIC 40–SMC



MODUTRONIC 30–SMC

SMC

TROUBLESHOOTING

MODUTRONIC 30 OR 40 SMC ACTUATORS

If the set up and calibration procedure was followed but proper operation was not obtained, check the following first:

1. Is three-phase power properly connected to the unit?
2. Is 120 volts A.C. present between terminals TB3-1 and 4 on the comparator board? If not check the control transformer connections.
3. Does feedback voltage (from comparator terminal TB4-3 to TB4-9) move in the proper direction on opening the valve? (See Set Up and Calibration Procedure Preseting Section A-11)
4. Is the coupling tight on the feedback potentiometer shaft?
5. Are all wiring connections tight?

Symptom—Actuator will not run—even in manual mode. (unit in mid-travel—limit switches set.)

Modutronic 30 only:

1. Check solid state reverser fuses. If blown fuses are found replace all three. Test unit. Using an insulated jumper (with unit in mid-travel) short solid state reverser terminal TB2-4 to either TB2-3 or TB2-5. Caution—120 VAC is present on these terminals.

If the unit now runs this indicates that the solid state reverser and fuses are good. The problem is with the comparator or wiring from the comparator to the solid state reverser.

If the unit does not run upon shorting TB2-4 to 3 or 5 replace the solid state reverser.

Modutronic 40 only:

1. Check for a tripped overload relay. If overload is tripped allow unit to cool and test unit. Using an insulated screwdriver or wooden stick depress the plunger on the electromechanical reverser. The motor should run. If not check motor.

Troubleshooting Procedure for Modutronic 30 and 40 is the same from this point on.

2. Check for a voltage reading across limit switch 8A to 50 and 7A to 40 and across torque switch terminals 50 to 55 and 40 to 45. If 120 volts (nominal) is present across any one of these terminals that contact is bad. Consult the Limitorque representative. If no voltage is present across these contacts energize the open pushbutton or short comparator board TB4-6 to TB4-10. Now read the voltage across the comparator output (TB3-6 to TB3-7). If there is 120 volts present this indicates that the open output solid state relay on the comparator is not operating. Now short comparator board TB4-6 to TB4-10 and read the voltage across the comparator output (TB3-6 to TB3-8). If there is 120 volts present this indicates that the close output solid state relay on the comparator is not operating. If either one of these conditions occurs replace the comparator board.

Symptom—Unit will not operate in automatic mode

1. Check that when the unit is in automatic mode there is no short circuit between TB4-7 and 8 on the comparator board.
2. Check that the input signal is connected with the positive going to TB4-11 on the comparator board and the negative going to TB4-9 on the comparator board.
3. Check that the proper calibrating resistor for your input signal is installed between TB4-11 and 9 on the comparator board.

Symptom—The full range of the analog input signal does not result in the full valve even with maximum span adjustment.

1. Check span adjustment zero adjustment.
2. Check for proper calibrating resistor value. (See Page 3 Command Signal Wiring)
3. Check that the analog input signal is of proper value.
4. Check geared limit switch adjustment (See SMBI-180).

Symptom—As the actuator follows an input signal, control is erratic throughout the range, that is, the operator will not track the input signal smoothly.

1. As the actuator is moved (in manual mode) from open to close monitor the feedback voltage from TB4-3 to TB4-9 it should go smoothly from approximately −4.8 volts to +4.8 volts. If the voltage takes a sudden jump from one direction to the other the feedback pot is adjusted such that it is being driven beyond its end point. It will then be necessary to loosen the set screw on the feedback potentiometer shaft and re-adjust the position of feedback potentiometer wiper.

If the voltage is erratic as the actuator moves from open to close the feedback pot may have become contaminated with dirt. Replace the pot.

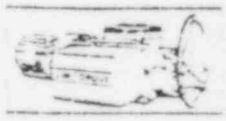
Symptom—Large input signal variations result in little or no movement of the actuator.

1. Check deadband setting. It may be too high.
2. Check span setting.

Do not attempt to repair either the solid state reverser section or the comparator section of the Modutronic. This will cancel the warranty if it is in effect.

If the set up and calibration procedure and the troubleshooting procedure are followed and you are still unable to get the Modutronic to operate properly please call the nearest Limitorque office. Give them the actuator order number and serial number (found on actuator nameplate) and a description of the malfunction.

LIMITORQUE CORPORATION



LUBRICATION INSPECTION PROCEDURE & DATA

GENERAL

Proper lubrication is an absolute essential in achieving the design life of all types of power transmission products and Limitorque valve controls are no exception.

The design of the actuator has been specially tailored to absolutely minimize the maintenance and re-lubrication requirements; however, periodic inspection is the only way to guarantee trouble-free service.

Limitorque utilizes a totally sealed gear case factory-packed with grease. The gear case can be mounted in any position (as all penetrations into it are sealed); however, those mounting positions which would cause vulnerable areas of the operator (e.g., motor and limit switch compartment) to be saturated with lubricant should a seal failure occur, should be avoided if possible and are not recommended. Grease is used in normal service instead of oil to minimize the impact of a seal failure (should one occur).

No seal can remain absolutely tight at all times: therefore, it is not unusual to find a very small amount of weeping around shaft seals—especially during long periods of idleness such as storage. The use of grease minimizes this condition as much as possible. Should a small amount of weeping be found in the limit switch compartment on start-up, it should be removed with a clean rag. Once the equipment has begun operating, this phenomenon should disappear.

LUBRICATION INSPECTION

It is recommended that all Limitorque operators be inspected for proper lubrication prior to operating—especially if they had been stored for a long period of time.

FREQUENCY

The frequency of lubrication inspections should be based upon historical data on the installed equipment. Every operator application has its own effect on lubricants and each facility should pattern its inspections around its particular needs. The following schedule of lubrication inspection should be followed until operating experience indicates otherwise.

Main Gear Case: Inspect lubrication on approximate intervals of 18 months or 500 cycles—whichever occurs first. Lubricate the Zerk fitting in the housing cover at the same interval.

Geared Limit Switch: Inspect lubrication on approximate intervals of 36 months or 1000 cycles—whichever occurs first.

The three primary considerations in a lubrication inspection are: (I) Quantity; (2) Quality; 3) Consistency.

Quantity - Limitorque operators are built to operate on the partial immersion principle. The primary concern in the amount of lubricant is whether the "worm" is totally immersed in grease. This can be verified by the use of one or more of the many "fill" and "drain" plugs provided on the operator housing.

Quality - When removing a "fill" or "drain" plug to inspect the lube level, remove a small amount and insure that it is clean and free of any contaminant including water. Should dirt, water, or other foreign matter by found, the units should be flushed with a commercial degreaser/cleaner like Exxon VARSOL #1 or #3 which is non-corrosive and does not affect seal materials such as Buna N or Viton. Repack unit with fresh lubricant.

Consistency - The main gear box lubricant should be slightly fluid approximating a standard NLGI-1 grade consistency or less. Thinners such as Amoco WAYTAC #31 oil may be added provided the volume of thinner does not exceed 20% of the total lubricant.

The geared limit switch lube should be soft to the touch approximating an NLGI-2 consistency or less.

Standard Lubricants
*(– 20°F to 150°F)

United Size	Type	Manufacturer	Color	Base
SMC-04 & 03	Nebula EPO (Rev.1)	Exxon	Dark Tan	Calcium Complex
**SMB/SB/SBD 000,00	Nebula EPO (Rev.1)	Exxon	Dark Tan	Calcium Complex
**SMB/SB/SBD/WB 0 to 4	Nebula EPO (Rev.1)	Exxon	Dark Tan	Calcium Complex
SMB/WB-5	50 EP (XC-421-39)	Sun Oil Co.	Black	Lithium Lead
**All HBC Sizes	Nebula EPO (Rev 1)	Exxon	Dark Tan	Calcium Complex

*Temperature rating based on continuous ambient vs. the time interval for inspection.

**For nuclear containment safety related active units, Nebula EP0 is used.

SMB/SB/SBD-000 & 00 lube was changed from Sun 50 EP (XC-421-39) to Nebula EP0 on all unit serial numbers 295810 and higher.
SMB/SB/SBD/WB 0 through 4 lube was changed from Nebula EPI to Nebula EPO on all serial numbers 302362 and higher.
All HBC sizes lube was changed from Nebula EPI to Nebula EPO on all serial numbers 302262 and higher.

GEARED LIMIT SWITCH:

Humble Oil Company - Beacon 325—Light Gray - acceptable substitute Mobil 28.

MOTOR BEARINGS:

Motors furnished with Limitorque valve controls are lubricated for life.

LUBRICANT SUBSTITUTES:

Typical commercially available lubricants other than those used by Limitorque for which manufacturers data indicates compatability with Limitorque operators are shown below with the temperature range recommended by the manufacturer.

Manufacturer	Type	Temperature Range	Base
Exxon	**Humcle P290	– 40°F to 120°F	Lithium Line
Arco	Litholine HEP1	– 10°F to 220°F	Lithium
Gulf Oil	Gulfcrown EPO	– 20°F to 220°F	Lithium
Cities Service	City AP	– 0°F to 220°F	Lithium
Mobil Oil Co.	Mobilux EPO	– 10°F to 220°F	Lithium 12
Shell Oil	Darina 0	– 10°F to 250°F	Hydroxystearate No Soap
Fiske	Lubriplate Low Temp.	– 40°F to 150°F	Lithium
Texaco	Marfak 0	+ 20°F to 200°F	Sodium
	Low Temp. EP	– 40°F to 200°F	Lithium
Tidewater Oil	Veedol Alitho 10	– 10°F to 150°F	Lithium

** Tested and used by Limitorque for applications at low temperatures (-50°F to -70°F). Consult Limitorque if the temperature range is beyond the limitations shown above.

The standard lubricants used by Limitorque have been proven extremely reliable over many years of service. There are, however, many other lubricants available which may be used *in place of* the standard.

Do not add a different lubricant to a Limitorque operator unless it is of the same soap base as the existing lubricant unless you have received the approval of the lubricant manufacturer.

The minimum lubricant qualities required by Limitorque are:

1. Should contain an "EP" additive.
2. Must be suitable for the temperature range intended.
3. Must be water and heat resistant and non-separating.
4. Must not create more than 8% swell in Buna N or Viton.
5. Must not contain any grit, abrasive, or fillers.
6. Must slump — prefer NLGI grade 0 to 1.
7. Must not be corrosive to steel gears, ball or roller bearings.
8. Dropping point must be above 316°F for temperature ranges of – 20°F to 150°F.

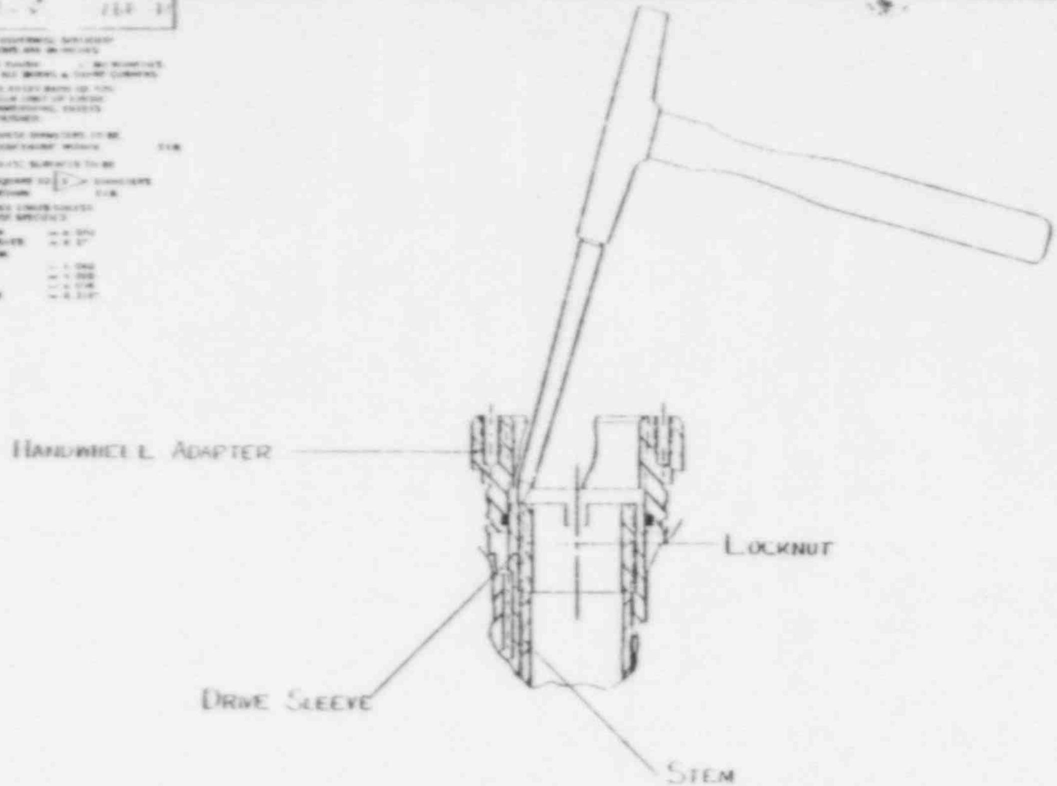
8/15/76
Rev. 1 - 12/21/76
Rev. 2 - 9/1/78
Rev. 3 - 6/12/79
Rev. 4 - 10/16/79
Rev. 5 - 10/10/80

LUBRICANT REQUIREMENTS

UNIT SIZE	Amount of Lubricant	
	Approx. Volume Gallons	Approx. Weight Pounds
SMC04	.15	1.0
SMB/SB-000	.50	3.5
SMB/SB/SBD-00	.50	4.0
SMB/SB/SBD/WB-0	1.00	9.5
SMB/SB/SBD/WB-1	1.50	15.0
SMB/SB/SBD/WB-2	1.75	14.5
SMB/SB/SBD/WB-3	5.50	50.0
SMB/SB/SBD/WB-4	8.50	75.0
SMB/WB-4T	8.00	71.0
SMB/WB-5T	7.50*	65.0*

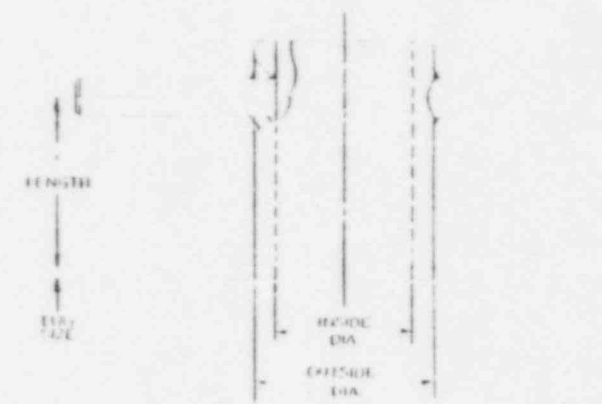
*Add 1 gallon/7 lbs. for thrust bearing assembly in SMB5 thrust-type unit.

H0BC	.20	1.5
H1BC	.35	3.0
H2BC	.50	4.0
H3BC	1.40	12.0
H4BC	3.50	30.0
H5BC	5.20	45.0
H6BC	9.25	80.0
H7BC	14.50	125.0
H10BC	26.00	225.0



STEM NUT REPLACEMENT & LOCKING INSTRUCTIONS

1. SPOT [illegible] PRIOR TO LOCKNUT REMOVAL.
2. REMOVE LOCKNUT FROM DRIVE SLEEVE. [illegible] OF HANDWHEEL ADAPTER A SPECIAL WRENCH SUCH AS SHOWN BELOW WILL FACILITATE REMOVAL BUT IS NOT REQUIRED FOR SAME. THEN REMOVE OLD STEM NUT.
3. DROP NEW STEM NUT INTO DRIVE SLEEVE [illegible]. TAP NUT [illegible] TO MAKE SURE IT IS BOTTOMED IN THE DRIVE SLEEVE.
4. SCREW IN LOCKNUT UNTIL THE TOP IS FLUSH (APPROX) WITH TOP OF DRIVE SLEEVE AND TIGHTEN WITH WRENCH.
5. THEN STAKE LOCKNUT IN PLACE AT TWO POINTS [illegible] USING STAKING TOOL AS SHOWN.

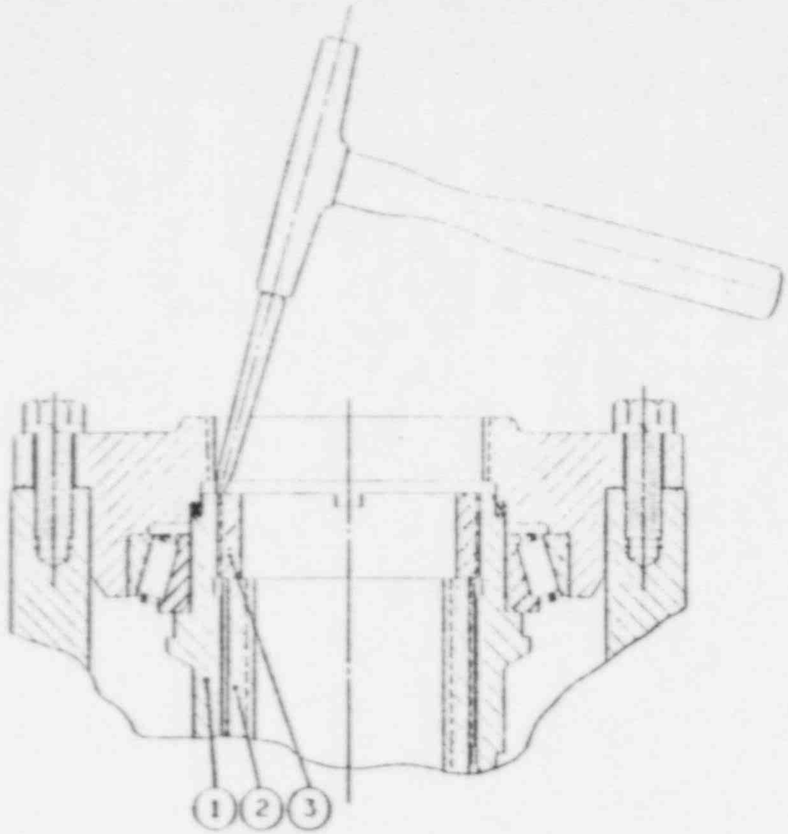


NUT WRENCH

NUT WRENCH DIMENSIONS

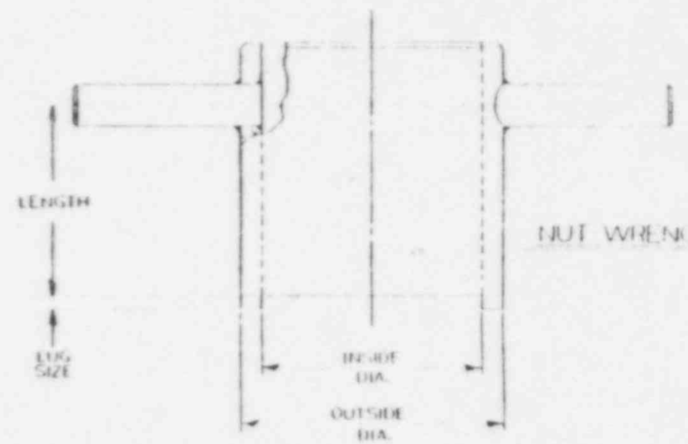
	LENGTH	OUTSIDE DIA	INSIDE DIA	LUG DEPTH	SIZE WIDTH
SMC 03	2 1/4	2.00	1.42	.25	.34
SMC 04	1 1/2	1.31	1.06	.25	.22

LIMITORQUE CORPORATION	
NAME	LOCKING NUT ASSEMBLING INSTRUCTION
DWG NO	21-417-0013-3
DATE	3-7-78
SCALE	FULL
SHEET	1 of 1
DRN	R.A.
APPVD	DWW



STEM NUT REPLACEMENT & LOCKING INSTRUCTIONS

1. [illegible] STAKES PRIOR TO LOCKNUT REMOVAL.
2. REMOVE LOCKNUT (1) FROM DRIVE SLEEVE (3) THRU OPENING OF HOUSING COVER. A SPANNER WRENCH SUCH AS SHOWN BELOW WILL FACILITATE REMOVAL BUT IS NOT REQUIRED FOR SAME. REMOVE OLD STEM NUT (2).
3. DROP NEW STEM NUT (2) INTO DRIVE SLEEVE (3) THRU SPLINES. TAP NUT [illegible] TO MAKE SURE IT IS BOTTOMED IN THE DRIVE SLEEVE.
4. SCREW IN LOCKNUT (1) UNTIL THE TOP IS FLUSH (APPROX.) WITH TOP OF DRIVE SLEEVE (3) AND TIGHTEN WITH WRENCH.
5. THEN STAKE LOCKNUT IN PLACE AT TWO POINTS, 180° APART, USING STAKING TOOL AS SHOWN.



NUT WRENCH

NUT WRENCH DIMENSION TABLE

UNIT SIZE	LENGTH	OUTSIDE DIA.	INSIDE DIA.	LUG SIZE DEPTH	LUG SIZE WIDTH
SMB HMB — 000	4 1/2	1 3/4	1 7/16	3/16	11/32
SMB HMB — 00	6 1/2	2 3/16	1 7/8	3/16	15/32
SMB HMB — 0	4 1/4	2 13/16	2 7/16	5/16	15/32
SMB HMB — 1	4 1/2	3 7/16	3	5/16	15/32
SMB HMB — 2	5	4 3/16	3 9/16	5/16	15/32
SMB HMB — 3	5	6	5 1/8	5/16	19/32
SMB HMB — 4	5 1/2	6 1/2	5 1/4	5/16	3/4

REV.	DESCRIPTION
A	[illegible]
B	
C	
D	

REVISIONS

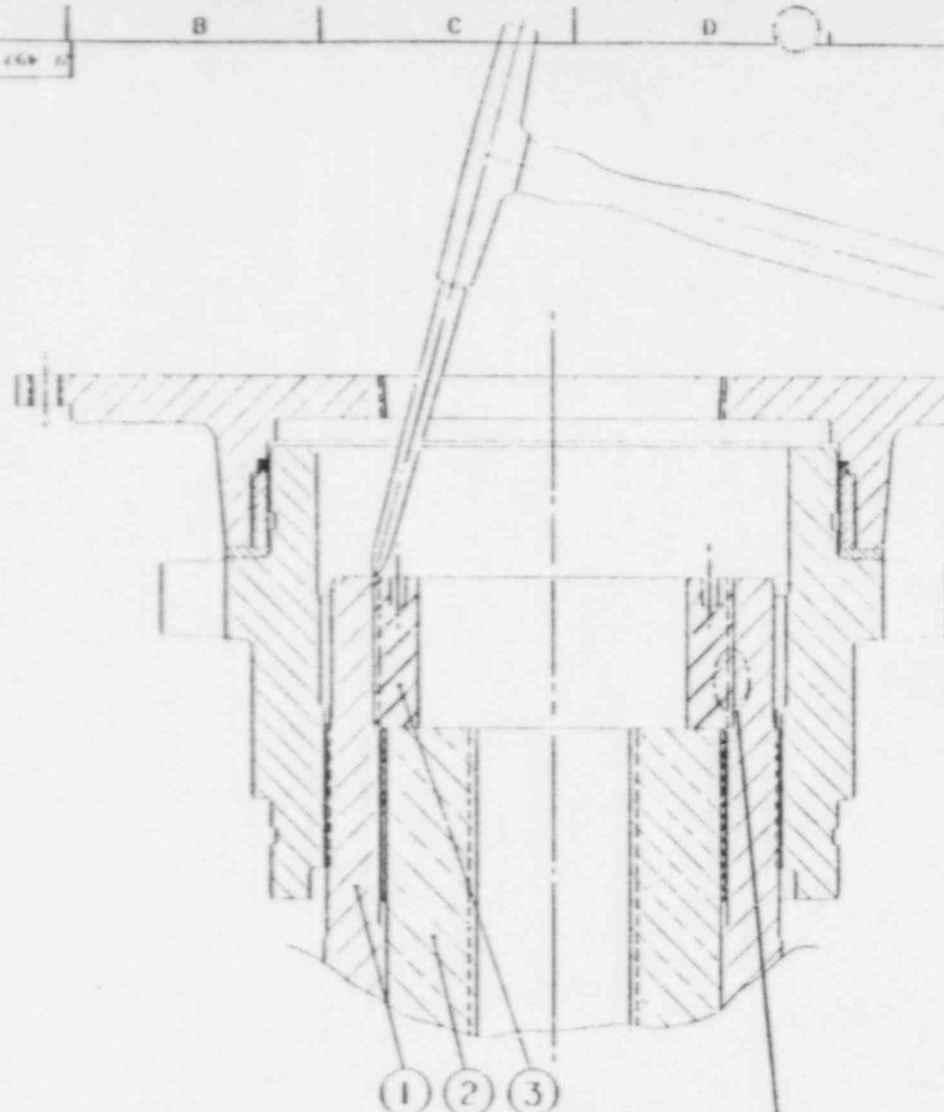
LIMITORQUE CORPORATION

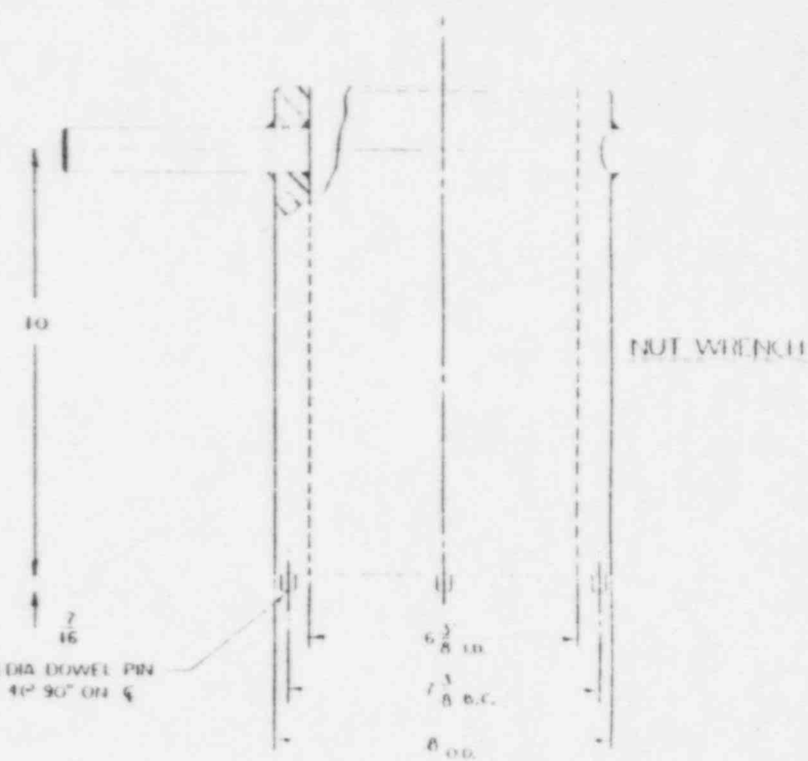
NAME: LOCKNUT ASSEMBLY INSTRUCTIONS

DWG. NO. [illegible] REV. A

STEM NUT REPLACEMENT & LOCKING INSTRUCTIONS

1. SPOT DRILL STAKES PRIOR TO LOCKNUT REMOVAL.
2. REMOVE LOCKNUT (3) FROM DRIVE SLEEVE (1) THRU OPENING OF HOUSING. COVER A SPECIAL WRENCH SUCH AS SHOWN BELOW WILL FACILITATE REMOVAL BUT IS NOT REQUIRED FOR SAFE REMOVE OLD STEM NUT (2).
3. DROP NEW STEM NUT (2) INTO DRIVE SLEEVE (1) THRU SPLINES. TAP NUT SLIGHTLY TO MAKE SURE IT IS BOTTOMED IN THE DRIVE SLEEVE.
4. SCREW IN LOCKNUT (3) UNTIL THE TOP IS FLUSH (APPROX) WITH TOP OF DRIVE SLEEVE (1) AND TIGHTEN WITH WRENCH.
5. THEN STAKE LOCKNUT IN PLACE AT TWO POINTS 180° APART USING STAKING TOOL AS SHOWN.





LIMITORQUE CORPORATION

NAME: LOCKING NUT ASSEMBLING INSTRUCTION

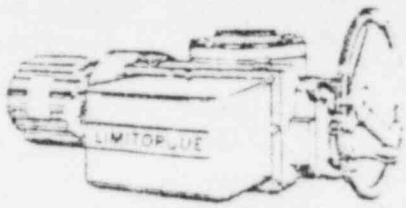
SMB 5

DWG NO 21 497 0010 3 REV A

DATE 3 10 76 SCALE HALF

REVISIONS: A REDRAWN

LIMITORQUE VALVE CONTROLS



LIMITORQUE CORPORATION • P. O. BOX 11318 • LYNCHBURG, VIRGINIA 24506

IEEE 323 (1974) and IEEE 382 (1972)
NUCLEAR QUALIFICATION DATA
FOR SAFETY RELATED SERVICE

	THREE PHASE ONLY		D.C.
	Nuclear Containment (See Option 8 Price Adders)	Outside Containment (Standard Prices)††	Containment—Inside or Outside (See Option 8 Price Adders)
Design Life	40 years (2000 cycles)*	40 years (2000 cycles)*	40 years (2000 cycles)*
Ambient Temperature (Continuous)	140°F	120°F	120°F
Ambient Humidity	60-100%	30-100%	30-100%
Aging	Motor Stator only 180°C for 100 hours	Entire Unit 165°F for 200 hours at 100% relative humidity	Motor Armature, Field Coils, & Brush Box only 180°C for 100 hours
Total Radiation (40 yrs. integrated)	2.04×10^8 rads	2×10^7 rads	1.0×10^7 rads
Seismic Ref: IEEE344	**6.0 g's (SMB/SB) ***3.0 g's (SMB/HBC) ****6.0 g's (SMB/HBC)	** 6.0 g's (SMB/SB) *** 3.0 g's (SMB/HBC) **** 6.0 g's (SMB/HBC)	**6.0 g's (SMB/SB) ***3.0 g's (SMB/HBC) ****6.0 g's (SMB/HBC)
Number of transients	2	2	1
Transient Temperature	340°F (BWR) 300°F (PWR)	250°F	340°F
Test Humidity	100% (saturated)	100% (saturated)	100% (saturated)
Profile	PWR/IEEE382-72 Page 12, Table 1 BWR/IEEE382-72 Page 12, Table 2	ANSI (yet to be published)	Special
Length of Test	30 Days	15 Days	25 Hours
Completed Test Date	PWR—September 1974 (600456) BWR—September 1972 (600 376)	February 1975 (600461)	October 31, 1975 (B0009)

*During BWR test, 500 cycles were used as a design life per IEEE382.

During PWR test, 2000 cycles were used as a design life of which 500 were incorporated prior to test and 1500 after test.

During test for outside containment, 200 cycles were incorporated while the actuators were being aged, and 1800 were added prior to irradiating.

During D.C. test, all 2000 cycles were incorporated prior to irradiating.

**As of 7/26/75, seismic tests were completed to IEEE344-1975 for both SMB and SB units to 6.0 g's vertical and 3.2 g's horizontal. Since no cross coupling was noted between axes, the test qualifies the SMB/SB to 6.0 g's in both vertical and horizontal axis. Maximum g-level dwells in each of the three axes qualify the units for any mounting position. (Seismic Qualification Report No. B0037). Qualification extends through 35 Hz.

††Standard Class "B" insulated motors only.

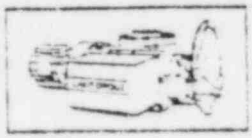
***Standard units without spur attachments.

****Standard units with seismic support bracket and without spur attachments.

NOTE: SMC-04 and SMC-05 actuators are qualified for "Outside Containment" service per above levels based on their similarity to the SMB actuator.

LIMITORQUE CORPORATION

5114 Woodall Road • P O Box 11318 • Lynchburg, Virginia 24506
Telephone—804-528-4400 • Telex—82-8448



Reply to:
DRIVE SYSTEMS INC.
5335 River Road
New Orleans, La. 70123
Phone: 504-733-8375

July 19, 1982

L P & L
Waterford III
P.O. Box B
Killona, LA 70066

Attention: Mr. Dick Rose
Mechanical Maintenance Department

Dear Mr. Rose:

In response to your request, we are enclosing a copy of our bulletin no. 18-57 which includes a drawing and parts list for your W-2 manual valve operator. Please note that your unit has a 32:1 worm gear ratio and a spur gear attachment with a 4:1 ratio.

We hope this information will be useful to you. If you have any questions or if we can be of any further service, please call us.

Yours very truly,

LIMITORQUE CORPORATION

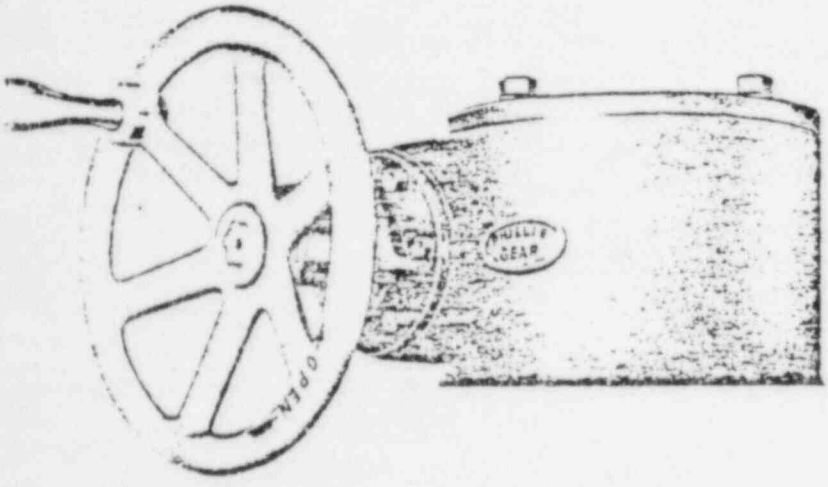
Thomas B. Ferguson

TBF/as

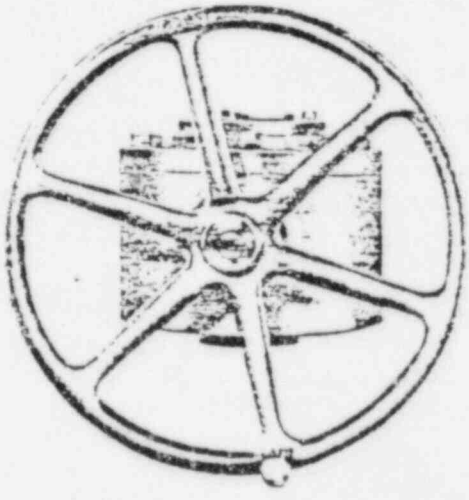
Enclosure

PHILADELPHIA

TYPES W & B MANUAL OPERATORS
(HAND OPERATED UNITS)



TYPE W (WORM GEAR) MANUAL OPERATOR



TYPE B (BEVEL GEAR) MANUAL OPERATOR

For valves, sluice gates, heavy doors or other mechanisms which must be controlled manually but requiring a mechanical advantage between the handwheel and the valve stem or input shaft, LimiTorque provides the "W" (WORM GEAR) or "B" (BEVEL GEAR) units.

Both types of manual units are completely interchangeable with the type SMA, SA and HM LimiTorque motor drive units and therefore will use the same valve yokes, stem nuts and valve stems. Torque and thrust ratings are exactly the same as for the comparable size motor units. This will also allow for future motor operation without any valve changes.

Handwheels are normally furnished with these units. Available handwheel sizes are listed in following tabulations.

Where necessary an additional gear set can be added at the unit input shafts to reduce handwheel effort. These are available in spur gearing providing for parallel shaft operation or in bevel gearing for right angle operation.

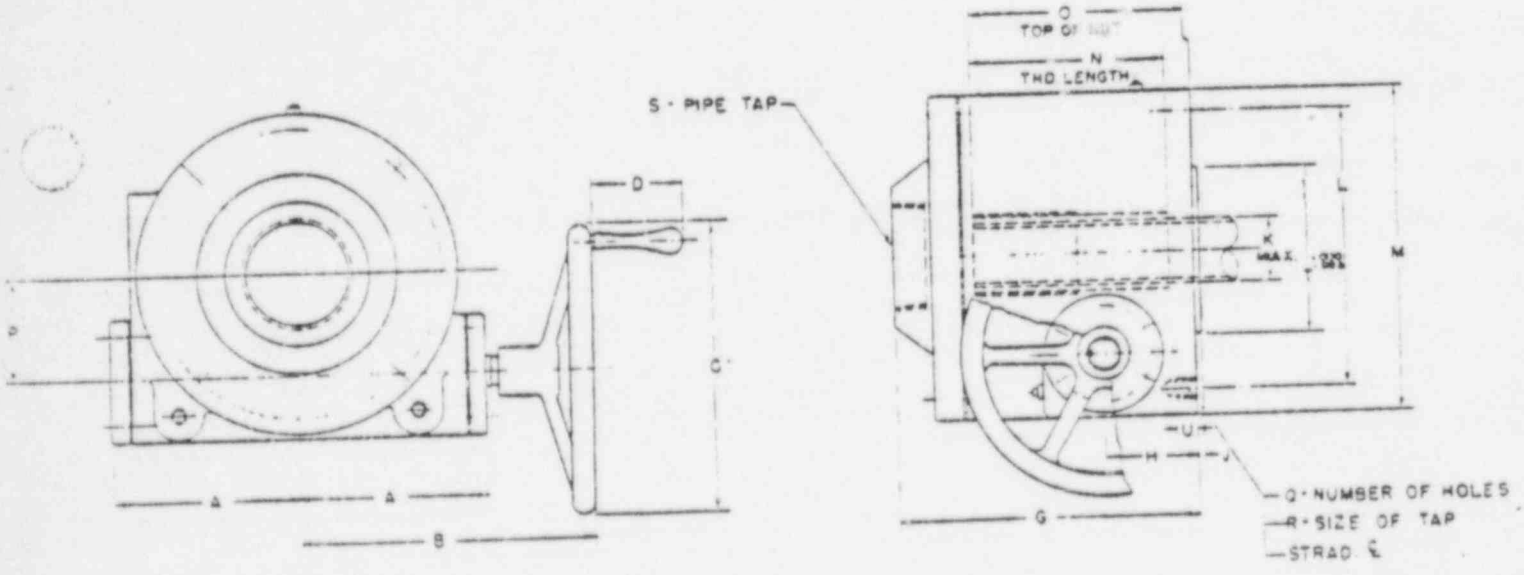
Handwheel operation is always clockwise to close with left hand valve stem threading unless otherwise specified. Hammerblow feature is designed into all units and units are available with mechanical position indicator, duplicating those furnished with our LimiTorque type SMA motor units.

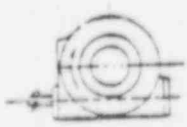
TYPE W (WORM GEAR) MANUAL OPERATOR

SIZE	RATING TORQUE =	RATING THRUST =	*AVAILABLE HW SIZES	**STD WORM GEAR RATIOS	ADDITIVE INPUT SHAFT GEAR RATIO
W0	320	18,000	12"	12.3 : 1 30 : 1 45 : 1	
W1	550	35,000	12" & 18"	14 : 1 32 : 1 63 : 1	4 : 1
W2	1250	50,000	18"	16 : 1 [illegible] 57 : 1	4 : 1
W3	3300	100,000	18" & 24"	10.3 : 1 16 : 1 41 : 1 57 : 1	6 : 1
W4	4300	150,000	24" & 36"	11.6 : 1 17.5 : 1 45 : 1 53 : 1	6 : 1

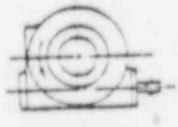
*Smallest diameter handwheel listed is STD.

**Other ratios available depending on stock holes.



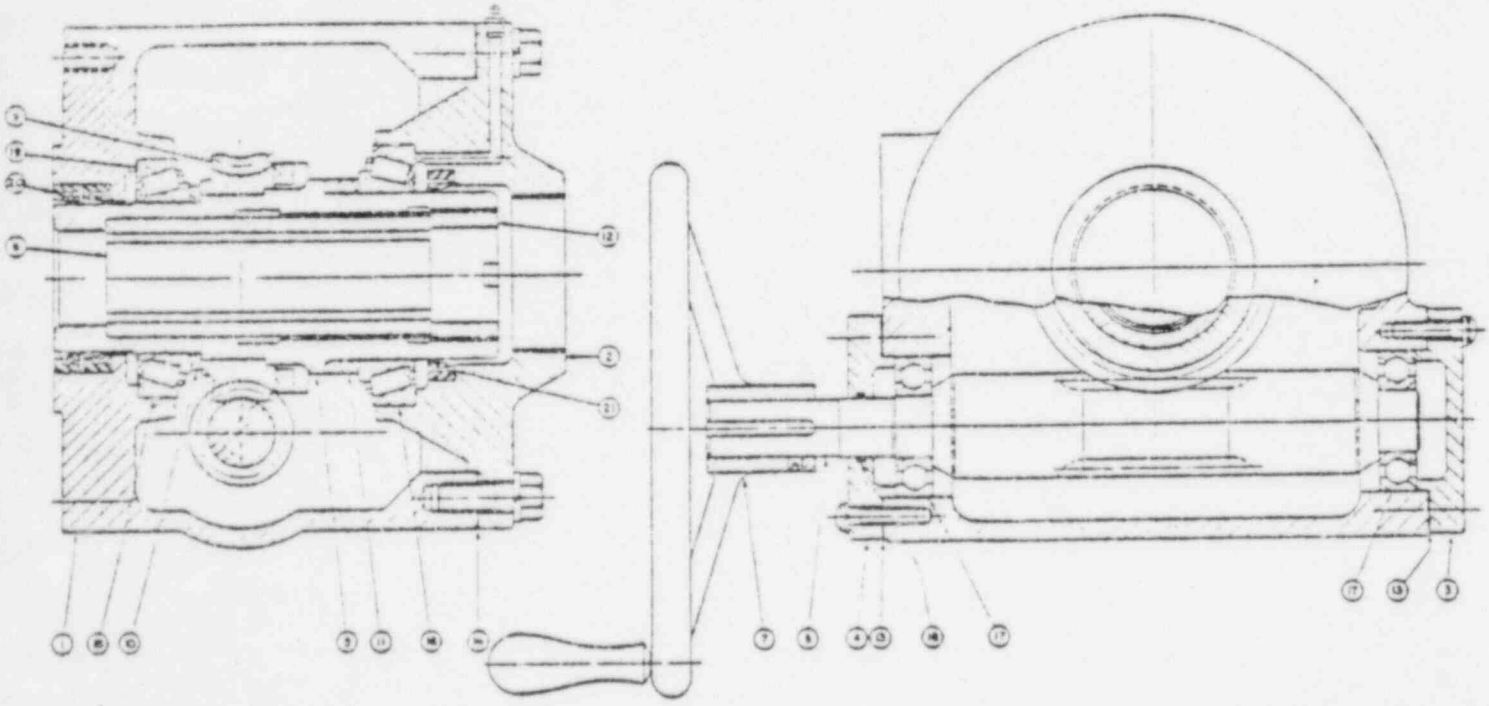


POS "B"



POS "A"

UNIT SIZE	A	B	C	D	G	H	J	K	L	M	N	O	P	Q	R	S	T	U
W-0	5 1/8	9 1/4	12	4	10	3 11/16	3/4	1 13/16	6 1/2	8 1/8	6 1/16	7 1/8	2 1/2	4	3/4 — 10	2 1/2	5	1
W-1	6 7/8	11 1/4	12	4	11 3/16	4	3/4	2 1/4	10	11 3/8	7 7/16	8 1/4	3 1/2	8	3/4 — 11	3	6	1
W-2	7 13/16	12 3/8	18	4	12 1/2	3 15/16	3/4	2 3/4	11 3/4	13 1/2	8 1/4	9 1/4	4 1/4	8	3/4 — 10	4	7	1
W-3	9 1/4	13 3/4	18	4	13 13/16	5 1/8	3/4	3 1/2	14	16	9 3/8	10 1/2	6	8	1/2 — 9	5	8 1/2	1 1/4
W-4	10 1/16	14	24	4	16 1/8	6 1/8	1	4 1/2	16	18 3/4	11	12 3/8	7	8	1 1/4 — 7	6	9	1 1/2



PARTS LIST

ITEM NO.	NAME
1	HOUSING
2	HSG COVER
3	END COVER (BLIND)
4	THRU CAP
5	DRIVE SLEEVE
6	STEM NUT
7	HANDWHEEL

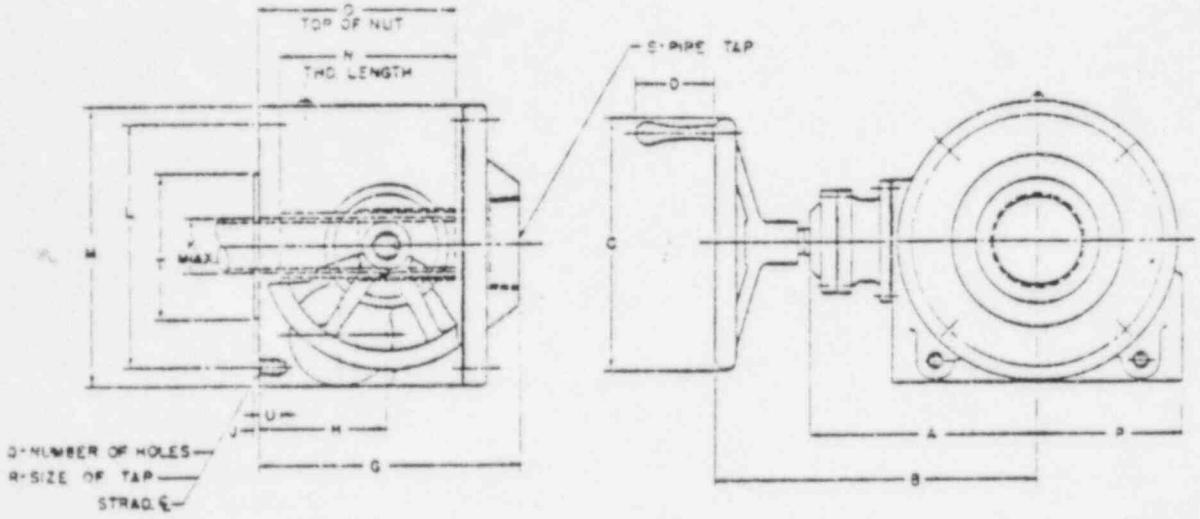
ITEM NO.	NAME
8	WORM SHAFT
9	WORM GEAR
10	W.G. SPACER
11	TOP BRG SPACER
12	LOCKNUT
13	BEARING CAP GASKET
14	HSG COVER GASKET

ITEM NO.	NAME
15	LOWER DR SL BEAR'G
16	UPPER DR SL BEAR'G
17	BALL BEARING
18	O RING
19	SHIM SET
20	HSG OIL SEAL
21	HSG COV OIL SEAL

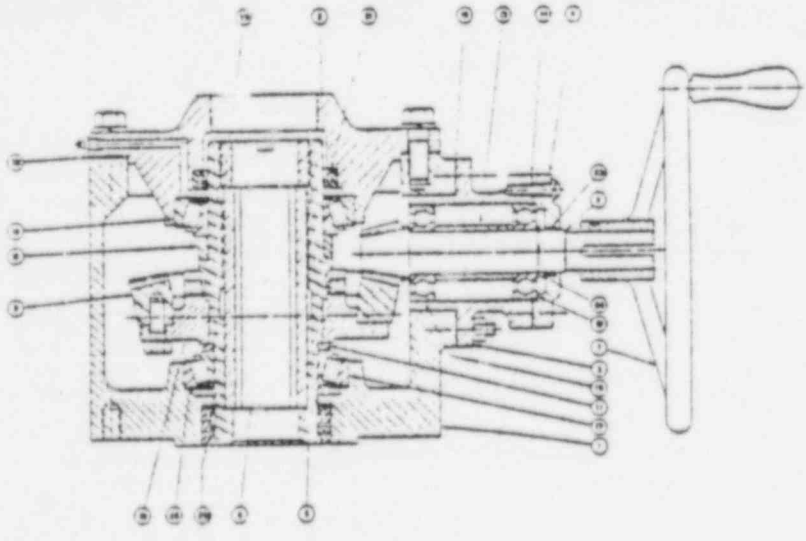
TYPE B (BEVEL GEAR) MANUAL OPERATOR

SIZE	RATING TORQUE #	RATING THRUST #	*AVAILABLE HW SIZES	GEAR RATIO	ADDITIVE INPUT SHAFT GEAR RATIO
80	330	18,000	12"	4 : 1	
81	950	35,000	12" & 18"	5 : 1	4 : 1
82	1250	50,000	18"	5 : 1	4 : 1
83	3000	100,000	18" & 24"	5 : 1	5 : 1
84	4300	150,000	24" & 36"	6 : 1	6 : 1

*Smallest diameter handwheel listed is standard.



UNIT SIZE	A	B	C	D	G	H	J	K	L	M	N	O	P	Q	R	S	T	U
B-0	7 13/16	12	12	4	10	5 7/16	3/16	1 13/16	6 1/2	8 1/4	6 1/16	7 1/16	4 11/16	4	1/4 — 10	2 1/2	5	1
B-1	9 1/2	13 1/8	12	4	11 3/16	6	3/4	2 1/4	10	11 3/8	7 3/16	8 3/16	6 1/4	8	3/8 — 11	3	6	1
B-2	10 5/16	14 1/8	18	4	12 1/2	6 3/4	3/4	2 3/4	11 3/16	12 1/2	8 1/4	9 1/16	7 3/4	8	3/4 — 10	4	7	1
B-3	12 1/8	16 3/4	18	4	13 13/16	7 1/8	3/16	3 1/2	14	16	9 3/8	10 3/8	8 5/16	8	7/8 — 9	5	8 1/2	1 1/4
B-4	13 1/2	17	24	4	16 1/4	8 1/8	7/16	4 1/2	16	18 3/4	11	12 1/2	9 11/16	8	1 1/4 — 7	6	9	1 1/8



ITEM NO.	NAME
1	HOUSING
2	HOUSING COVER
3	PINION SHAFT CARTR.
4	CARTRIDGE CAP
5	DRIVE SLEEVE
6	STEM NUT
7	HAND WHEEL

ITEM NO.	NAME
8	BEVEL PINION SHAFT
9	BEVEL RING GEAR
10	BEVEL GEAR SPIDER
11	BEVEL GEAR SPACER
12	TOP BEAR'G SPACER
13	PINION SHAFT SPACER
14	CARTR. CAP GASKET

ITEM NO.	NAME
15	CARTR. GASKET
16	UPPER DR. SL. BRG.
17	LOWER DR. SL. BRG.
18	BALL BEARING
19	BALL BEARING
20	HOUSING OIL SEAL
21	HOUSING COV. OIL SEAL

ITEM NO.	NAME
22	HOUSING COV. GASKET
23	O RING
24	RETAINING RING
25	LOCK NUT
26	SHIM SET

PHILADELPHIA GEAR CORPORATION
KING OF PRUSSIA (SUBURBAN PHILA.), PENNA.
Offices in all Principal Cities

DELIVERY SCHEDULE	LIMITORQUE CORPORATION	ORDER NO.
8-9-76		394811-B
QUANTITY	UNIT SIZE & TYPE	CUST. ORDER NO.
11	W-2 MANUAL	C0971OA-ADD 1

ASSEMBLY POS. "A"

TAG:
STOCK NO. 80226, S.J. ITEM 39 (1)EACH: 6CD-V311, THRU 321

NO. REQ'D.	PART NO.	DESCRIPTION	MATERIAL	MAKE STOCK BUY	REMARKS
11	———	W-2 MANUAL 32:1 RATIO		S	
11	60-406-0091-3	WORM SHAFT	1140 ALLOY	M	
11	B-308188	WORM GEAR	BRZ.	M	NO LOST MOTION
11	———	4:1 SPUR GEAR			SHEET 2
11	60-509-0195-9	18" DIA. HANDWHEEL	C. IRON		
11	P-90	STEM NUT			CUSTOMER TO TAP

DRAFTSMAN	CHECKED BY	DATE ISSUED
C-	O K-1	DEC 26 197

SHEET 1 OF 2 SHEETS